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The Public Lighting Tables of the American Meter Company will be found in the page advertisement of that Company.

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RETROSPECTIVE AND PERSPECTIVE.

In gas stoves, many new designs in both heaters and ranges have come upon the market. We must commend the endeavors of the manufacturers of this line of goods to produce an article that will be economical in the consumption of gas, neat in appearance and comparatively inexpensive. We do not think that they have been accorded proper support by the gas companies, and it is with regret that we note that the strenuous efforts heretofore exercised by the gas companies to place as many cooking and heating stoves as possible, have been in a great measure relaxed. We cannot believe, because competition from other lighting agents has lessened, that gas companies do not longer consider it necessary to solicit the use of gas for other than illuminating purposes. We know that it required sharp competition to stimulate active efforts to secure consumption some years ago, and we shall very much deplore the necessity of such competition again arising to spur the gas men on to sell every foot of gas that can be sold. We do not believe that perfection has been reached in the manufacture of gas cooking and heating appliances, and it would indeed be sad to know that inventors and designers should turn their attention to other devices because of indifferent encouragement upon the part of the gas companies whose strongest allies they are. There is still a large field open in every city for the introduction of gas stoves, and it is certainly possible and very probable that with the advantages of gas as a fuel, properly presented, every customer can be won over to its use as such.

We will now address our remarks more directly to those upon whose management the financial success of a gas plant is largely dependent. By way of preface, we will state that what follows is not prompted by any desire to criticise those whose opinions may differ from ours, nor is it our intention to cast any reflection upon methods that are at variance with those we deem best suited to accomplish the most satisfactory results. Our readers will please bear in mind that our province is to lay before them, impartially, that which our personal experience—corroborated by the returns that daily come to our notice through channels not generally accessible—teaches us to be of the highest value in the conduct of a gas company's business. Our mission is the dissemination of knowledge for the general welfare of the gas profession, and our only wish is to perform this duty thoroughly and thus assist those whose interests it is our pleasant task to serve.

In making up their annual reports, some of our readers will, perhaps, find that the results attained have not been wholly satisfactory. Many items, of themselves small, but collectively quite appreciable, will be in evidence and will serve to detract largely from what would otherwise have been a highly flattering statement. The question of leakage or output unaccounted for, will, no doubt, be the most serious and will furnish food for some very deep thought upon the part of him who has the practical end of the business in charge. To this party we would suggest that great stress be laid upon the advisability of securing a reduction in the leakage account, and that he should urge upon his Board of Directors the necessity of getting at the work promptly and efficiently. This is too important an item to be regarded lightly, and no expense should be spared in effecting a radical change for the better. We are aware that unfortunate differences often arise in many companies between

the heads of the engineering and commercial departments, whereby the engineer or superintendent is handicapped in not being able to determine monthly what the percentage of leakage is. Why these differences should exist is enigmatical to us, and we cannot too earnestly impress upon these gentlemen the absolute necessity of perfect harmony in the discharge of their several duties. Both should certainly feel that their stockholders' interests are paramount, and that petty jealousies and dissensions are not conducive to the welfare of those who intrust them with the care of their investments. Such information as would lead to improvement should be freely and unreservedly given on both sides, and nothing but concerted action should be allowed to enter into the administration of both branches of a company's business.

Many causes may be assigned for the loss due to unaccounted-for gas. High water lines in the station meters, variations in temperatures under which the gas is measured at the works, slow or non-registering consumers' meters, and faulty mains and services, are very prolific sources of the discrepancy between gas sent out and gas accounted for. Of the above, the mains and services will be found the most noteworthy. As a rule, altogether too little attention is given to the distributing system. Mains and services that have been in use for years are seldom overhauled until some flagrant cause for complaint arises, and even then, perhaps, the repairs made are but temporary. Unfortunately, this practice is generally followed and cannot be too severely condemned. It appears to us that it is an easy matter to prove the beneficial results to be obtained from a perfect system of mains and services, and we cannot but believe, if the seriousness of the situation is carefully put before a Board of Directors and a systematic mode of procedure suggested, that the necessary appropriation for the work will be immediately forthcoming.

The returns we have received from the various companies throughout the country show a decided increase in output, and go to prove the truth of what we have repeatedly said, that the best days of illuminating gas in the United States are not only not over, but have yet to come. We hope that each succeeding year will bring the same highly satisfactory showing. We would urge upon the gas men to consider the opportunities for gas. Let them carefully reflect upon their individual conditions and determine when and where to strike for additional business. Let their arguments, whether verbal or written, be unique and interesting, and let them approach a possible customer with the air of one who has something to sell that will distance all competitors. Persistence and untiring efforts are the price of success, and if one becomes disheartened because of a few refusals it is hardly probable that his assistance will long be found of value. It must be remembered that every line of business is "drummed" for all there is in it to-day, and why should not this apply to the gas business as well? It should be borne in mind that a great deal of money is tied up in main and service pipes and consumers' meters. If these are allowed to remain idle during the day, the item of interest must necesarily figure largely against the earning capacity of the plant; whereas, if a day consumption of gas is had, the returns therefrom would go largely towards wiping out interest charges, and, in time, probably yield a surplus.

The matter of residuals is one which we cannot pass unnoticed. The market for coke, tar, sulphate of ammonia and other bye-products is not, we will admit, very good, but in this era of low prices and general depression, we cannot say other than that the figures realized are certainly fair. But little improvement has been made in the apparatus used for working up bye-products, and we think that the absence of necessary assistance that should come from gas engineers is largely to blame for this state of affairs. We hope to see more pronounced exertions shown in this line in the future, and we have no hesitancy in saying that the residual products obtained in the manufacture of gas will at no very distant day prove more than ever a fruitful source of revenue to gas companies generally.

Before concluding our remarks, we think that a few words touching upon the relations of gas companies to their consumers will not be out of place. We know that usually a gas consumer is considered to be the most exacting and unreasonable of beings. This may be to some extent true, but in some cases we believe that just cause will be found for his position.

We regret to have to say it, but it is none the less so, that a consumer's complaint was formerly, and, for that matter, even now at times is received with but scant courtesy. These same consumers deal with people in other lines of business and are accustomed to being listened to patiently and to have their wants attended to with a show of willingness and desire to please. His complaints may seem very trivial to the company, but he may regard them in quite another light. Why not hear him out and show him that you appreciate his custom and are desirous of retaining it. It costs nothing to be polite, and a very bitter enemy may be made a staunch friend through exercising a little diplomacy and showing that your only wish is to give him perfect service.

We wish to compliment the gas profession generally upon the success with which it has met and surmounted the many difficulties that have beset it during the year, and extend our heartfelt good wishes to one and all for an even more successful and satisfactory season in 1896.

Tower Scrubbers and Horizontal or Washer Scrubbers.

By Mr. William Newbigging.

[Read before the Quarterly Meeting of the Manchester District Institution of Gas Engineers, Leeds, Eng.]

One of the tendencies of recent years among gas managers is that of dispensing entirely with the tower scrubber, and placing reliance on one or other of the various forms of horizontal or washer scrubbers for eliminating the ammonia impurity from the gas. The objection raised against the tower scrubber is that it fails in its primary duty—viz., that of the removal of the ammonia impurity. It is with a feeling of regret that I am forced to the conclusion that in many cases the charge is true. Of all the apparatus on a gas works, the tower scrubber has, perhaps, the most pleasing, or at least imposing, appearance; but if it has still to retain its place among modern gas works appliances, good reasons must be forthcoming for its retention—efficiency before appearance being the cry, and rightly so.

The usual and proper custom in gas works where tower scrubbers are erected in pairs, is to put weak ammoniacal liquor from the hydraulic main and the condensers through the first, and clean water through the second vessel. The weak liquor, having a strong affinity for carbonic acid and sulphureted hydrogen, materially lessens the work of the purifiers by extracting a proportion of these impurities, in addition to bringing the liquor up to the requisite commercial strength. The second scrubber, through which clean water passes, removes the last traces of ammonia remaining in the gas.

This is the view we have always had of the action that takes place; and theoretically it is correct. But as practical men, we know well that an apparatus that will so effectually distribute the liquor, or the water, as the case may be, in such a manner that the whole of the surfaces exposed to the gas in its passage shall be evenly wetted, has yet to be invented. The water often finds its way into one channel, while the gas is passing round and about it, but untouched by the falling water. Especially is this the case where tower scrubbers are filled with coke. The wood boards, though far from perfect, were a step in the right direction, as also are the canvas screens; but whether coke, or wood, or canvas screens, in a scrubber which exceeds 9 feet in diameter it is impossible to insure efficient and equal water distribution. This is, of course, as much due to imperfections in the distributor as in the filling material; and so the ammonia passes forward, to the injury of the consumers' fittings, and a consequently smaller amount standing in the books to the credit of the liquor. More especially is this the case where reliance is placed on a single tower scrubber.

Now, while deprecating the entire abolition of the tower scrubber, the advent of the washer scrubber has necessitated an alteration in the usual arrangement and functions of the tower. When erecting a new plant, I would recommend that one tower scrubber only be provided, to be worked in conjunction with a washer-scrubber. The arrangement would be as shown in the following diagram:

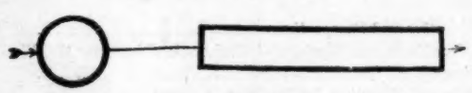

Fig. 1.

Weak ammoniacal liquor is passed through the tower scrubber and clean water through the washer scrubber. The tower scrubber will remove a large proportion of the ammonia and other impurities, and is useful for the purpose of working up the liquor to the requisite strength, while the washer-scrubber will remove the last vestige of the ammonia from the crude gas.

Where there are already two tower scrubbers in existence, I should arrange them as shown in the second diagram; passing weak liquor through the tower scrubbers, and clean water through the washer-scrubber:

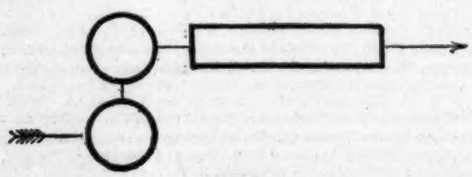

Fig. 2.

When the make of gas has increased to such an extent that still further scrubbing power is required, a second washer-scrubber should be

added, and the arrangement would then be as shown in Diagram No. 3.

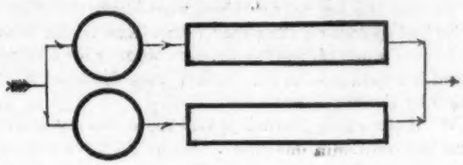

Fig. 3.

Whichever of the two forms of apparatus be used, it is indispensable for their efficient action that the tar should be removed from the gas previous to its entering same. However efficient a condenser may be, it leaves much of the lighter tars untouched, and these go forward, to the detriment of the efficient working of the scrubbers, and also to the injury of the gas. Take an extreme case: Assume the scrubber to be largely impregnated with tar, and the gas passed through it in the ordinary way, the illuminating power of the gas would suffer materially. For that reason a tar extractor should be fixed at the bottom of every tower scrubber to do this work, which more often than not is left to the scrubbers themselves—a duty which they were not constructed to fulfill.

There are various forms of washer-scrubbers in the market, and many managers are in doubt which to adopt. Each maker naturally claims his own as the best, and only actual and varied experience under different conditions will determine that point. The persuasive eloquence of a good traveler has found a place for apparatus in many a gas works which, for all the use it is, might as well never have been fixed. On the other hand, there are machines by various makers which work steadily the 24 hours round, requiring little attention and removing all traces of the ammonia impurity. As regards cost, there is not much difference between the tower scrubber and the washer-scrubber. The latter is more easily protected than the former against the frost and snow in winter and the rain and sun in summer, as a light shed can be erected over it; whereas a tower scrubber is exposed to all weathers, and consequent wide variations in temperature. Being nearer to the ground, a washer-scrubber is also more under the control of the foreman, who, if an elderly man, or one possessed of weak nerves, hesitates to climb to the top of the tower. The manager, also, can more easily ascertain whether the apparatus is fulfilling its functions. He arranges the flow of water in such a way that he always has several of the compartments clean, knowing thereby how much power he has in reserve.

In conclusion, I would say that experience has taught me that a combination of the two forms of apparatus, in the way I have shown, is the best.

Discussion.

The Chairman said a feature of Mr. Newbigging's paper was that he took a different line from the one usually followed, in recommending that the tower scrubber should take the second place to the purifying machine, or mechanical washer-scrubber, in the order of the flow of the gas. He did not agree with the conclusions that Mr. Newbigging came to, inasmuch as, at the present time, he was working two large tower scrubbers, and should have a mechanical scrubber for sale very shortly (laughter). His object in working tower scrubbers in preference to mechanical washers was that it was essential, in purifying gas from ammonia, that the flow of gas through the vessel should be as slow as possible; it afforded facilities for doing something else besides extracting the whole of the ammonia. Of course, the gas contained a good deal of ammonia, in the form of cyanogen, that was never recovered; and in tower scrubbers it was possible to decompose the cyanogen. By putting in a little alkali with the water over the scrubber, the alkali combined with the cyanides and broke them up, and the nitrogen of the cyanides combined with the nascent hydrogen in the gas, and formed ammonia, thus increasing its yield. This was a thing he could not speak upon with any special data at the present moment. But it was a reaction that did absolutely take place in the tower scrubber, and besides it was one that could only be obtained by giving prolonged contact between the gas and the water or the soda solution. Whether at present the decomposition of these cyanides paid for the cost of the soda he was not yet prepared to say; but he believed it did. At all events, there was a great deal to be hoped for in the way of increasing the yield of ammonia from the gas. With coal containing 1¼ per cent. of nitrogen—that was, calculating it out, equal to 140 pounds of sulphate of ammonia per ton of coal—they considered they were getting a large yield if they obtained 27 or 28 pounds of sulphate. All this nitrogen went away in some manner. Some was broken up in the retort, and some went down as ammonia; but a large quantity went away as cyanide. He considered that a large tower scrubber was the most suitable apparatus for the recovery of the cyanides, and if they were to be got and sold commercially it could not be done by rapid contact through a purifying machine. This was the reason he was discarding his mechanical washers and going back to the old tower scrubbers of large capacity.

Mr. William Carr (Altrincham) felt very much disappointed with the paper. He thought that they should have had some statement or some argument put before them, either that the tower scrubber or the washer-scrubber was the best. Here they were fronting "north by south"—a combination of both was best. However, he was much obliged to Mr. Newbigging for having brought forward the paper. It reminded him of the one read by the late Mr. Ogden at one of the Institution meetings in Manchester, on which occasion he thought the best discussion was heard that had ever taken place on the question of scrubbing and washing. The matter was then fairly threshed out, as they thought. They came to the conclusion most decidedly that the tower scrubber possessed advantages which the washer or horizontal scrubber did not. Mr. Newbigging had pointed out some objection to the tower scrubber, as to its height and the difficulty of protecting it, and also the fact that, in consequence of being filled with improper material, it was very frequently inefficient, and passed gas without taking out the ammonia. This, to his (Mr. Carr's) mind, all came from the want of intelligent use of the tower scrubber. Mr. Newbigging said the filling of the scrubbers with boards was a step in the right direction, and he agreed with him that it had only been a step—not because the boards were defective in any shape or form, but because gas engineers had never attempted to solve the question as to how near or how far apart the boards should be. Of course, in the past—say, 15 years ago—there were not so many gas managers who were also sulphate makers, and it was then an important consideration to sell liquor of high strength. In those days, the liquor in the north of England was sold under Twaddel's hydrometer, and the more carbonic acid and sulphureted hydrogen they could cram into the liquor the more they realized for it—they were really selling carbonic acid and sulphureted hydrogen for ammonia. In some places, when high tower scrubbers were first adopted—he remembered notably the case of Elland, where they had two high towers, which were very much in excess of the requirements of the works—they sold a large amount of liquor in comparison with other works. To a gas manager of that time it must have been a desirable thing to do. As so many purchased liquor by the Twaddel hydrometer, the more stuff gas managers could put into it, to get the hydrometer well up in the liquor, the better it was for them. The people who bought the liquor got alive to this, and commenced to buy it by the ounce and by the distillation test. Then came the process of gas works putting down sulphate plants of their own. There was no particular advantage in then loading the liquor up, because they had to deal with the sulphureted hydrogen themselves after it left the liquor; and so the question had grown a little complicated since that time—the advantages of the tower scrubber being lessened thereby. They had had long discussions in that and other Institutions as to the desirability of the purification of gas in closed vessels; and many attempts had been made to purify gas with the liquor, and to absolutely do away altogether with the need of purification by lime or oxide. To his mind, this had always been a possibility, and he still thought it was possible that such a thing might be done. Mr. Livesey, under his purifying liquor process, had accomplished a great deal in the tower scrubber in removing large quantities of impurities from the gas. The celebrated Claus process came next, and it bid fair to get them out of all their difficulties. He remembered when his brother and himself went to Birmingham to see the experimental Claus plant there, which was working in a most efficient way, so they were told by the engineers who had it in charge and by the representative of Mr. Claus. They had the privilege of testing the gas that was being worked by it; and, so far as they could ascertain, the gas was absolutely purified. Why the process never got beyond the experimental stage at the Windsor street gas works at Birmingham, he was never able to see. But since that time there has been a trial on a large scale at Belfast, and it had been given up there. He remembered the discussion that took place at the Gas Institute on this question, on which occasion he said that the only difficulty he could see in the way of such a process was the mechanical appliances that were necessary to work the liquor over the different towers. It was then proposed by Mr. Claus that duplicate pumps should be obtained, so that one could always be ready in case the other went wrong. But he sug-

gested that one might go wrong; and the other being put to work, that also might go wrong before the first one was again ready for work. Mr. C. E. Jones had ridiculed him at that meeting, and said it was not the habit of gas engineers to let their plant get into such a condition that the moment it was started it broke down. Still, he (Mr. Carr) did not know the reason for the failure of the process. It all pointed to the fact that there was the possibility of more being done with the scrubber or scrubbers than was being accomplished now. They were at present satisfied to take out the free ammonia wherever scrubbers were at work, but he believed that some attempt had been made by Messrs. Davis and Belton to split up the cyanides as his brother (the Chairman) had suggested. What would be the result of this process he was not in a position to say; but he would press upon all managers who had to deal with the question that the scrubbing and washing of gas was about the least interesting of any part of gas manufacture at the present time. It was the subject that had received least attention, and yet it was one of the most important in connection with the gas industry. With regard to the filling of tower scrubbers—and therein was the secret—coke, boulder stones and screens had been used. He had been in a gas works where he had seen a man splitting up old packing cases with which to fill the scrubber. The packing case had come over the Atlantic ocean, and the boards of which it was composed were an inch thick. The man was using strips of these boards to keep them apart; and so in his scrubber he was having inch interstices between the boards. A man doing this showed his absolute want of knowledge in regard to the real principles of scrubbing. As his brother had already intimated, what they wanted was length of contact, and to insure contact. Notwithstanding the fact that the gas might be a long time passing through the scrubber, if it did not come in contact with the interfilling material, it might as well go through a plain pipe or an empty scrubber. Gentlemen who had given any attention to the subject of the flow of gas would know that it was fastest away from the surface or where there was no friction. If they had boards that were 1 inch apart, it would be found that about seven eighths of the gas passed up the center of the aperture; whereas only one-eighth dragged along the surface. An ideal scrubber would be one in which they had sufficient area in diameter, and in which they had boards ½-inch apart. With a scrubber containing boards ½-inch in thickness and ½ inch apart, they would require nothing more than a good distributing apparatus at the top. This, he agreed with Mr. Newbigging, was a thing that was very difficult to get, particularly for large diameter scrubbers. Of course, if they were only going to use ammoniacal liquor for the scrubber, they could have a splash plate, and send the gas at great force through the plate. Then the difficulty arose of getting an equal distribution for a scrubber that was something like 9 or 12 feet in diameter. His personal experience was that he had found as much difficulty in getting the distribution of the water in a mechanical or horizontal washer as he had in a tower scrubber. He was bound to say, although he had been able to get the gas clean with mechanical washers, that he had never been able to do much more than take out the free ammonia. With a washer 15 feet long, filled half way up to the center, and with the upper surface curved and filled with machinery, the gas could not be very long in its passage through. Consequently, the usefulness of the apparatus was very greatly mitigated by that circumstance. In the case of the tower scrubber, if they would only take out the tar, he thought they could get far more efficiency with one scrubber than with half-a-dozen washers. If they had length of contact, the two articles or substances—the water and the gas—came together for such a long time, in the slow passage of the water down the boards (if they had sufficient boards near together), that the gas might be washed to an extent that had been scarcely dreamt of up to the present time. He did not know all efforts for using purified liquor had been given up. He believed a new patent had been taken out lately, and probably they would hear something more of it. There was one point with reference to the tar that Mr. Newbigging had mentioned—as to reducing the illuminating power of the gas. It reminded him of a circumstance that came under his notice in his early days as a gas manufacturer, where a number of tower scrubbers were ranged together, and where the liquor was pumped over in the form he had mentioned—namely, by a splash plate. One of the foremen, when he found that the illuminating power of the gas was getting too low, used to lower the suction pipe down into the tar, and pump tar over the scrubbers, with the effect that the illuminating power was increased as much as 1½ candles. The mechanical action of driving the tar against the splash plate must have had the effect of vaporizing some of the tar; he could only explain it in that way. But the fact was certainly correct, that it did increase the illuminating power by 1½ candles. It was only in cases of passing gas through tar of great density that there was any considerable reduction of illuminating power. He did not know what kind of tar Mr. Newbigging alluded to; but he (Mr. Carr) did not think any tar that reached the scrubbers would have the effect he stated. Although he had spoken on the paper rather against its tenor, at the same time he was much obliged to Mr. Newbigging for having read it; and he hoped it would lead to the further consideration of the scrubbing question by the members.

Mr. W. W. Hutchinson (Barnsley) said there was one point that Mr. Newbigging had omitted in his paper. He might have said something as to the advantage of dealing with the tower scrubbers with a liquor of a certain density in one, so as to get a high strength of liquor, and a liquor of lower quality in the others. He fancied this was one way in which great advantage might be derived. For the reason that it had not been convenient yet, he had not done much in this way himself. But he had, in times past, heard of members who had been working in this direction; and he should like to have their experience. He had himself found some difficulty with tower scrubbers in keeping the illuminating power in good order in their new works at Barnsley. Frequently, in the winter, he had to shut off one or two of them, on account of the extreme cold prevailing having a detrimental effect on the illuminating power. He really rose for the purpose of asking for information with regard to using a separate tank and a separate pump for liquor of varying densities for each tower scrubber.

Mr. T. Bower (West Hartlepool) said at one part of his career he was very much in favor of tower scrubbers; but some seven or eight years ago he veered round rather towards mechanical scrubbers. At the works with which he was now connected he put in a mechanical scrubber in addition to two tower scrubbers, 45 feet high by 10 feet in diameter. He did not get the advantage that he hoped to do from the introduction of mechanical scrubbing. Shortly after, when he was considering the rearrangement of some of the plant, he made up his mind that it was desirable to get another tower scrubber. He put up one of the same size and capacity as the two he had previously, with the result that he procured considerable relief. He was not in a position to say that it increased his illuminating power to any great extent; but, on the other hand, it did increase the quantity of sulphate of ammonia he obtained per ton of coal carbonized. There was another point in which he found they were materially helped; and this had been referred to by Mr. Carr. He pointed out that in former days it was not so necessary for gas managers to consider the extraction of sulphureted hydrogen by their scrubbers as it was now, when chemical manufacturers looked very minutely into the percentage of the ammonia contained in the liquor. In his own case this did not apply, because the more sulphureted hydrogen he could extract by the tower scrubber, in addition to the extra quantity of ammonia, was really a double advantage, inasmuch as he manufactured his own sulphate. In connection with the sulphate plant, he had the Claus plant. So that, if he could extract a large amount of sulphureted hydrogen in the scrubber, he relieved the purifier of that duty; and in carrying the sulphureted hydrogen forward to his sulphate plant, he could extract the sulphur in a commercial form, whereas otherwise it would be lost. So far as the financial view was concerned, in this respect he found tower scrubbers to be a great advantage; and if he were called upon now to design an entirely new works, he certainly should lean towards an excess of scrubbing power rather than mechanical horizontal washers. When he was in Lancashire, he had a somewhat similar experience with regard to tower scrubbers. On the introduction of an additional tower scrubber there, he immediately found he had a considerably greater quantity of liquor than before. In Durham, they were not accustomed to get by any means the proportion of sulphate per ton of coal used that gas managers in Lancashire did. They were satisfied with 23, 24 and 25 pounds of sulphate per ton of coal; and they thought these were excellent results. He mentioned this because, in making comparisons between gas works in Lancashire and Durham, those in the latter county were often placed at a disadvantage. Any one who had had experience of Durham, Lancashire and Yorkshire coal would know that Lancashire and Yorkshire coal contained a larger proportion of ammonia than Durham coal.

Mr. C. A. Craven (Dewsbury) agreed very much with the author of the paper. He had had a tower scrubber, which was quite large enough to deal with all the gas they made up to a certain point; but he never found the scrubber to completely free the gas from ammonia. He was always able to get an ammonia test even in the summer time, when the make of gas was only a quarter (and even less) what it was in the winter. Some years ago they put up a mechanical scrubber, and he could speak very favorably as to the results. They had no difficulty at all in clearing the gas from all traces of ammonia. That was his experience.

He took exception to one remark made by Mr. William Carr. He seemed to think that when boards were placed in scrubbers they were put in in a vertical way, so that the gas could follow the same current from the bottom to the top. That was not the way he (Mr. Craven) had been in the habit of having them arranged. The boards he used were 7½ inches deep and ½ inch in thickness. These were crossed, so that the gas was bound to be broken up, and the breaking up caused it to impinge on the sides of the wetted boards. With regard to the quantity of ammonia, he did not think he had much ground for grumbling. He obtained and sold, on the average, 30 pounds of sulphate per ton of coal.

Mr. William Carr said he did not dream anybody would misunderstand him in the way Mr. Craven had done in regard to the placing of the boards. He assumed it was one of the elementary principles of filling scrubbers that the boards should be crossed. But if they had boards 1 inch apart, and they were crossed by others 1 inch apart, they would have a vertical column of 1 inch; if they were ½ inch apart, they would have a vertical column of ½ inch.

Mr. C. E. Jones (Chesterfield) agreed with Mr. Carr that inch boards for scrubbers were a mistake, and crossing them at right angles was also a mistake. The practice of filling scrubbers had been a very varying one. In the olden days, some 23 or 25 years ago, the finishing scrubber was packed with broken pots, earthenware, pieces of brick and other unconsidered trifles of that description. Many years ago he was an advocate for drain pipes, which were a great improvement over the rubbish that was put in formerly. Eventually he adopted this plan in the finishing scrubber. He had boards ⅝ inch in thickness and 7 inches deep, and he distanced them a little less than ⅝ inch. After the first layer was put in, the next layer was crossed—not at right angles, but at angles of something like 45°. The layers were crossed in the same fashion right to the top of the scrubber, so the gas in passing through would describe a spiral motion, would get broken up, and the bulk of it, in some part of its journey, would come in contact with the wetted surfaces of the boards. This scrubber had been most efficient and effective ever since it was constructed, and, except for painting, it had never cost anything for repair. The distribution was effected by means of a brush distributor. The water supply was conveyed into a tank with a ball tap, which fed another tank, and the filtration was effected by means of sponges, so that if the water contained anything likely to stop the pipes the obstruction would be arrested. As to the question of maintaining the efficiency of the scrubber in cold weather, he had a coil of steam pipes passing round inside the scrubber boxes. This was an advantage in the winter, as they never had any deterioration or lowering of the illuminating power, because the temperature of the scrubber could be actually increased to a greater degree than it was at the inlet or the outlet. Mr. Newbigging had shown the importance of removing the tar before it entered the finishing scrubber. He (Mr. Jones) agreed that this was most essential, but he did not agree that the washing of the gas with tar had no ill effect on the illuminating power of very rich gas. He had an opinion that it would be to the advantage of the gas industry if every tower scrubber were doubled in diameter, so that the gas would pass through them at a slower velocity. It would expand itself—it would be in a very attenuated form, and it would be in a condition more favorable for being acted upon by the liquor, whether weak or strong ammoniacal liquor or water. This additional increase of diameter he considered far more important than an increase in height. No doubt, from the purely chemical point of view, it was a long continuous contact with every particle of gas possible that they had to aim at. When they could effect this, he thought they would have brought tower scrubbers to a perfect condition. He had no ammonia in his gas at the outlet of the scrubber either in summer or winter, and he therefore concluded that the machine he had adopted for the removal of the ammonia was an efficient one. There was one other point that might be considered, that the rougher the board or material that created the scrubbing action the better would be the efficiency of the machine. He had heard it suggested that smooth iron should be used in place of boards, but this would be a mistake, because the gas would slide so easily over the smooth surface, which it could not do over the rougher surface of the boards. If he were to recharge the scrubber to which he had referred, he should feel disposed to put in thinner boards, and also to narrow the apertures to such an extent as to avoid any indication of back pressure. He would strongly recommend those managers who had not adopted boards to do so. Like everything else in a gas works, they could not scrub and purify gas by chance. The old rule of thumb days had passed away, and they must insure constant and personal attention in order to remove the ammonia from the gas.

The Chairman said Mr. Ford, of Stockton-on-Tees, had honored them with his presence that day. He had no tower scrubbers on his works, but if he were to tell his experience of working without them they would be much obliged.

Mr. W. Ford, in complying, said his experience of washers for the last twenty years, with the absence of tower scrubbers, had not been without some amount of trouble and anxiety. He must say this, that mechanical washers, where they had a man equal to a chemist to attend to them, were most perfect mechanical appliances; without such observation and knowledge he must say that washers were more likely to contaminate than do good to the purification of the gas. In the event of frost, by simply closing up the dampers in the condensers they could very easily regulate the temperature of the gas. He should not like to follow Mr. Jones in his introduction of the steam pipe. His experience had been that when ammoniacal liquor was heated up it caused it to evolve and so waste ammonia. After a very long series of experiments and practical experience with washers he had come to the conclusion that the only way to obtain satisfactory results was by either one or two mechanical washers and afterwards a tower scrubber, reversing the order of the method Mr. Newbigging had adopted.

Mr. Newbigging, in reply, said he was indebted to the various speakers for their contributions to the matter under discussion. The Chairman, in his speech, rather gave the impression that he (Mr. Newbigging) was holding a brief entirely on behalf of the washer-scrubber. He would refer him to the first portion of his paper, in which he stated that one of the tendencies of recent years was to put in washer-scrubbers and to dispense altogether with tower scrubbers. He read the paper with a view to showing that he considered it better to combine the two appliances in the order shown. Mr. Carr's experience with washer-scrubbers, seeing that he was going to remove one, must have been very unfavorable indeed, and he must have made an unfortunate choice when adopting the machine. If he remembered rightly, at the Widnes Gas Works they had only a Livesey washer or a tar extractor. (Mr. Carr: A purifying machine.) Then he could only repeat that, according to his own showing, he must have made an unfortunate choice. Mr. William Carr had remarked that no portion of the apparatus of a gas works was so little known as the scrubber. He agreed with him. There was a great difference between the duty which could be obtained from an apparatus that was carefully watched and its actions tested and an apparatus that was allowed to pursue "the even tenor of its way" without any one troubling to see what it was doing. To obtain the maximum duty from any apparatus well repaid a manager for the time and trouble it necessarily required. Mr. Carr also claimed that the tower scrubber was more effective than the washer-scrubber in removing other impurities than ammonia. On that point there was much room for difference of opinion. He did not think that anything had been said to alter the opinion he had expressed in the paper. Given a gas free from tar, a copious supply of liquor through the tower scrubber, a measured quantity of clean water through the washer-scrubber, and proper attention to the apparatus, and the best results would be attained.

Ventilation and Warming.

By Mr. Wm. T. Sugg.[1]

While there might be general agreement among architects and scientific men as to the fundamental principles of ventilation and warming, there were great differences of opinion as to how those principles should be put into practice; and he expressed the opinion that these differences are largely due to the fact that every building has its own special requirements, arising out of its situation, construction, and the uses to which it has to be put. Therefore it is necessary to take these points into consideration before arranging a scheme of ventilation and warming for any particular building. He cited the lavishly decorated rooms of first-class London restaurants and hotels as examples of the requirements being made to fit the scheme, and stated that with the advent of the electric light there appeared to have come a dead level of agreement among architects as to ventilation and warming—they will have none of it. He then proceeded to describe in detail the system in use in the Houses of Parliament, with a view of showing how the principle of suiting the scheme of ventilation and warming to the requirements of the building, as well as the adaptation of its structural advantages to the same end, has been worked out to a successful issue, and as indicating the most practical methods for other buildings.

In ventilating and warming the House of Commons allowance has

1. Abstract of a paper read before the Society of Civil Engineers, England, Dec. 2, 1895 and published in the *Gas World*.

to be made for the rapid changes in the number of people present in the Chamber, for the length of the sittings, and for the temperament of those present. It would be a comparatively easy matter to secure a regular flow of fresh air through the Chamber at a temperature of, say, 63° F., but experience has taught that that would not be satisfactory. The temperature must be gradually raised as the night advances, until, in the early morning, it may be as high as 75°; the nature of the debates, if listless or lively, must be taken into account, and there must not be too great a difference between the atmospheric temperature and that inside the Chamber. Fresh air is admitted to the Chamber through grated openings distributed over the floor and walls. The aggregate area of these openings is about one-eighth of the area of the Chamber, so that a considerable quantity of fresh air is admitted and distributed over the chamber without any perceptible velocity. The air is cleansed, warmed and properly moistened in a chamber below the floor of the house, and equal to it in area. The vitiated air is gently aspirated through numerous openings in the ceiling of the Chamber by means of Argand gas burners, which also serve to light the Chamber, and is then aspirated through a large flue to the base of the Clock Tower, which is made to serve as an upcast flue. The aspiration from the roof of the Chamber must be at such a rate that the temperature at the ceiling shall not exceed 84°, as, if the temperature is allowed to go beyond that, the emanations from the lungs and body will not rise through the upper stratum, except at such a rate as will amount to no ventilation at all. The upcast action of the Clock Tower is regulated by means of a coke fire in the base of the Tower, and Mr. Sugg thinks that the coke fire is the best arrangement for all buildings with high ventilating shafts; it costs less than do mechanical contrivances. Having explained the means adopted to clean and warm (the warming is done by steam) the air admitted to the Chamber, Mr. Sugg stated that the cleanest air is to be obtained in London at a level between 40 and 60 feet from the ground.

Proceeding to apply the lesson to be learned from the system adopted at the Houses of Parliament, Mr. Sugg said the principle that ruled the scheme was that the vitiated air must be induced to take a straight course to the ceiling, and not be given a chance to return to be breathed over again. The fresh air should be admitted at a great many points all round the room, at a low velocity; the natural rising of the vitiated air should not be disturbed; and the fresh air will take the place of the hot vitiated air by reason of its heavier specific gravity. Where the heating of the air by steam pipes under the floor is not feasible it ought to be done by means of radiators placed all round the chamber, as that will prevent the vitiated air from being cooled by contact with the walls. Then if the fresh air is admitted through funnelated openings about 6 feet above the floor, it will enter without draught and spread itself all over the chamber, under the vitiated air, which can be gently drawn from the top by means of properly regulated gas burners.

In the concluding portion of his paper Mr. Sugg described a system of ventilation he has arranged for the Egyptian Hall of the Mansion House, and another applied to the Board Room of the Gas Light and Coke Company. In the former case the ventilation is effected by means of sun burners, and in the other "Cromartie" lamps are used, which not only ventilate but also light.

The paper gave rise to a long discussion, in which the author's conclusion that the fresh air should be admitted at the lower level and the vitiated air taken away at the higher was generally objected to.

Mr. A. Rigg did not think the House of Commons' system had been a success, and what little success it had achieved was due not to the system but to the care bestowed upon its application. At equal temperature carbonic acid was 1½ times the weight of air, and therefore the natural way was to take the foul air out at the bottom and the fresh air in at the top.

Mr. Charles Gandon thought the House of Commons system was generally good, but it could not be applied to private houses.

Mr. J. Jefferies thought the taking of the air through the floor was most disgusting. He brought the air in above the level of the head, at a temperatre 2° or 3° below the general temperature of the room. For buildings of several floors he thought a central shaft, placed near the chimney to keep it warm, was the best method. He agreed that gas jets were the best and cheapest aspirators for small compartments.

Mr. W. Schonheyded condemned the House of Commons system. It was perfectly useless to attempt to keep the foul and fresh air separate, and that was the reason why so much fresh air was required in ventilation—to weaken the mixture.

Mr. P. Griffith said it was easy to arrange diagrams showing air currents, but these could be of no practical value unless the houses were built airtight. They had this paper upon ventilation from a gentleman associated with gas apparatus, and that gave him an opportunity of remarking that they were losing a valuable factor in ventilation. By dispensing with gas as an illuminant they were doing away with an evil that was apparent, but there remained an evil that was not so apparent. The foul air resulting from the combustion of gas was so pungent and objectionable that it demanded attention, and that removed there was a danger that respired air and emanations from the body, which did not make themselves so apparent, might be allowed to accumulate to a dangerous extent. The conditions might be more dangerous with electric lighting, though apparently healthier.

Mr. A. E. Hubert preferred to bring in the air at a high level and in a thin film. He would deliver the fresh air about 6 feet above the floor and draw the foul air off at the floor. Diffusion made it impossible to bring in air at one point and take it away at another; they could only hope to get the air so diffused that it would never become dangerous to breathe it. It was impossible to get ventilation without draught, because draught was simply air in motion. They could only minimize the draught by diffusing the air as much as possible.

Mr. M. Shillito described the system of ventilation in use in his own house. The air is admitted to the basement, where it is warmed; it is then carried to the several rooms, and finally finds its way to the chimney. No fires are used in the rooms.

Mr. Sugg, in the course of his reply, said the large amount of steam mixed with the carbonic acid would, by reason of its high specific heat, prevent the return of the vitiated air from the ceiling.

Chemical Action of Heat and Light.[1]

At a meeting of the French Chemical Society, M. Lemoine spoke of a series of experiments which he had undertaken to compare the effect of light and heat by means of the same chemical reaction. Bunsen and Roscoe have published some papers on the same subject, but Lemoine paid especial attention to selecting his reaction so that the same one could be applied to both. He selected a mixture of oxalic acid and ferric chloride, which is easily acted on by light in the cold and by heat in the dark. The liquid decolorizes, gives off carbonic acid and forms ferrous chloride:

$$Fe_2Cl_6 + C_2H_2O_4 = 2FeCl_2 + 2HCl + 2CO_2.$$

In the sun the gas is formed quite rapidly. Exposed to the electric light the action is very much slower. Solar light, either clear or reduced by various screens, was used by the author exclusively.

The proportion of the mass decomposed in a given time—that is, the ratio of the decomposition effected to the decomposition possible, is easily measured by the amount of carbonic acid given off or the amount of ferrous chloride formed. To measure the gas it may be collected over glycerine, in which it is practically insoluble. It is better to determine the ferrous chloride by titration with permanganate.

Action of Heat on the Mixture.—At a given temperature the rapidity of the action decreases as the mixture changes, but it is proportional to the existing active components at such time. Variations of temperature considerably affect the rapidity of action, as with almost all other chemical action. On comparing different strengths of solution, it is found that an excess of water accelerates the action; this is due to the decomposition of the chloride by water.

Action of Light.—Some preliminary experiments showed that the action was very slow in yellow light and quite rapid in blue light; neither violet nor ultra violet exerted any strong modifying effect. Suppression of light caused the action to stop quickly, or if there was any action it was so faint as to be imperceptible. By the aid of long calculations the author establishes the relation between the absorption by the reagent and its decomposition, and then the quantities decomposed in the first moments of reaction. These same formulæ may be used to determine the intensity of solar light, by using as a unit a certain amount of matter decomposed under certain standard conditions as to light, heat, etc.

Conclusions.—Chemical action produced by light or by heat follows the same laws. According to an idea of Berthelot, light serves only to promote the temperature at which the action would take place, or more exactly, it accelerates an action which would take place without it only in an almost infinite time. The calculations follow results of experiments. We can calculate what will occur in a decomposition of a certain given kind, in a vessel of a specified form with a definite light and heat strength or the reverse. The conclusions apply to solar light, but a method of investigation is shown which may be applied to others.

1. Translated and abstracted for the JOURNAL from the original paper as published in the November number of the *Annales de Chemie et de Physique.*

Resonance in Boiler Explosions.

By Lieutenant W. Stuart-Smith, U. S. N.[1]

Occasionally a boiler explodes under circumstances which make it exceedingly difficult to determine the cause. The evidence of those in whose charge the boiler is intrusted is to the effect that the steam pressure was not above the normal and water was carried at the proper height, so there could be no danger of explosion from overheated plates. An examination of the *debris* shows no evidence of overheating the metal of the shell, traces, etc., show good section, with no evidence of serious erosion, and a test shows the metal to be of good quality. With good metal of proper section and boiler well proportioned, it is manifest that rupture can only occur through excess of pressure, and the report of the examiners is that without doubt the fireman neglected his duty and allowed the pressure to reach a point which was beyond the strength of the metal to withstand.

In cases where the evidence in favor of the fireman proved to be so strong that no possible doubt could be expressed regarding the fact that the pressure was not excessive, and examination showed no defect in design or material, the necessity for an explanation brought forth theories to account for instantaneous development of enormous pressures. According to one of these, the water over the furnace crowns might exist in a spheroidal state—that is, be held out of contact with the plate by a layer of steam—in consequence of which the plate became highly heated, and the spheroidal state being broken, the water was brought into contact with the hot plate and flashed into steam, thus producing a sudden enormous pressure with a resulting explosion. The propounders of this theory did not realize that, owing to the large amount of heat rendered latent in evaporating a small quantity of water, the excess of heat in the plate would not be sufficient to evaporate any considerable quantity, even if such a spheroidal state, with consequent heating, would be possible with the rough plates and other conditions existing in a boiler.

Another theory that was much propounded was that water was decomposed by some electric action, and that the resulting oxygen and hydrogen, existing as a highly explosive compound in the proportions necessary for formation of water, accumulating in considerable quantity, was in some manner ignited, with resulting enormous increase of pressure and explosion of boiler. Apparently no consideration was taken of the fact that, even if oxygen and hydrogen were thus formed, they would pass off with the steam—hydrogen especially, on account of its low specific gravity, being very quick to do so.

At present such theories are scoffed at, and the verdict is that the pressure was allowed to become too great—a faulty steam gauge or other cause preventing a careful fireman from being aware of the fact. Such verdicts, however, are sometimes rendered solely because the examiners realize that excessive pressure must be the cause, and, rejecting what they know are absurd notions, they find themselves confronted with the necessity of assigning a valid reason.

Still, mysterious explosions sometimes occur, and the writer believes they may be caused by a sudden increase of pressure, and offers the following explanation, which, while it may, to some, seem as absurd as the theories quoted, is founded on strictly scientific principles and represents a by no means impossible condition.

Resonance has long been studied in relation to sound, but it is only within recent times that the very important place it may occupy in cases where force is transmitted by means of vibrations in elastic media has been realized. In cases where steam and other vapors and gases are used as the media for the transmission of force, this transmission is not accomplished by means of vibrations in the elastic medium, but the medium itself is strained, and being transmitted in mass to the point where it is desired to have work performed, it is placed in conditions favorable to the release of the tension. During this recovery from the strained state, work is performed equal in amount to the energy which disappeared in producing the strained condition. It is only in the case of those substances, such as gases and vapors, which are elastic and mobile in the highest degree, and which can have their volumes varied through wide limits without altering this state, that practical use, for purpose of performing continuous work, can be made of their tendency to recover from a state of strain. Other substances, such as ivory, glass, etc., are highly elastic, but the limits through which they can be strained are too narrow to permit of their use in performing continuous work.

Vapors and gases, possessing the property of elasticity in such high degree, are not only capable of receiving enormous static strain, and in this state, being transferred from place to place, but they are capable of being strained by an impulse received at one point, and of recovering from this state of strain by transmitting it to neighboring portions of the mass, thereby setting up vibrations which gradually die out, owing to the want of perfect elasticity. This fact being recognized, it is possible to offer a theory which the writer believes furnishes a correct explanation of many mysterious boiler explosions, and incidently accouuts for some peculiar looking indicator diagrams which are usually set down as water in the cylinder, inertia of the moving parts of the indicator, etc.

The distributing valve of the engine being closed, steam fills boiler, steam pipe and valve chest, and has no motion as a mass. The valve opens and permits steam to enter the cylinder, thereby giving motion to the mass of steam in the pipe, the velocity attained being, say, 100 feet to the second at the moment of cut-off. When cut-off occurs this motion is arrested at the steam chest, owing to the rigidity of the metal, but along the body of the pipe no such impediment exists, and owing to its inertia the steam continues its forward movement, compressing the portion before it until the resistance to compression finally brings the mass to rest. When this occurs the steam at and near the engine will have a density considerably in excess of that near the boiler, and there will be the equivalent of an impulse producing strain at one point of an elastic medium. The result will be that the recovery from the strained condition will send a wave toward the other end of the pipe and the boiler, which wave will tend to travel back and forth through the pipe with continually decreasing amplitude. The same thing will occur at the following and all other admissions of steam to the cylinder, so that, in addition to the periodically interrupted forward motion of the steam as a mass, there will be a series of waves continually traveling backward and forward through the pipe. If the time of propagation of a wave from the engine to the far end of the pipe and return differs materially from the time elapsing between cut-offs in the engine, the mass of steam will be filled with a series of vibrations moving in both directions, and differing in phase to such an extent that there will be so much interference as practically to eliminate all vibrations, and instruments will make no record of them. If, however, the conditions are such that the first wave formed travels forward and returns just as the wave formed by the second cutting off is ready to start forward the two will add themselves together and a single wave of increased amplitude but same wave length will go forward, with result that, in addition to the steady strain on the pipe due to the pressure of the steam, it will be subjected to waves of strain which pass along it. This occurring for several consecutive revolutions of the engine, the amplitude of the wave will, by resonance, be raised to a very large figure, and a very great strain be brought to bear on the pipe. Such a wave passing into the boiler and then rebounding will subject it to a *sudden* increase of pressure, much in excess of that due to the steam, and will have its effect increased owing to the fact that it will be applied as a live load. A sudden enormous increase of pressure in a boiler may be thus explained on a strictly scientific principle.

The energy due to the forward movement of the steam at one cutting off may be readily calculated. Suppose there is a 10-inch steam pipe 100 feet long, steam pressure 125 pounds. At this pressure there are 3.549 cubic feet of steam per pound, or the total quantity of steam in the above pipe will be 15.36 pounds. With steam, at moment of cutting off moving 100 feet per second, the energy of the moving mass of steam will be 2,385 foot pounds, which is the force which will compress the steam preparatory to the production of the first wave. In a very brief period, if the conditions are right for the production of resonance, this energy will be many times multiplied.

Such a condition of affairs is certainly possible, though it will occur only at rare intervals, and it is sufficient to account for some mysterious explosions. It is impossible to guard against, owing to the variety of conditions which are influential in producing it. In order that the maximum effect may be produced it is necessary that the primary vibration period of the steam in the pipe should correspond with the times of cutting off steam in the cylinder, and there is usually sufficient variation in the speed of the engine to perhaps greatly promote interference; moreover, the vibration period of the steam is itself continually changing, as it depends upon the elasticity of the steam, which is a continually varying quantity, since it is affected by every variation in the pressure and by every variation in the amount of entrained moisture. It might happen that a steam plant would operate for many years without the proper condition for maximum resonance occurring; then the proper relation of steam pressure, entrained moisture and engine speed might occur, and in a few moments a disastrous explosion would take place, with absolutely nothing to show the reason why. Steam pipes as well as boilers will explode from this cause.

1. From *Journal of Electricity*.

With regard to the engine indicator, it occasionally happens that an instrument which is in excellent condition and usually takes fine cards, is applied to an engine, and the cards show an admission line which rises far above the steam line, and even far above full boiler pressure. Sometimes this line falls back at once to steam line, and again it may inclose a small area before reaching this line. The expert thinks there is water in the cylinder, and, finding this is not the case, blames the indicator. There may in reality be water in the cylinder in some cases, and certainly indicators are sometimes to blame for such additions to the card, but it will be occasionally noted that some particular engine has a habit of showing such cards when the steam is dry and the indicator in good order. At times, even, there is a hump in the steam line between admission and cut-off. If our theory that resonance may cause, in the steam pipe, waves of considerable amplitude, is correct, we have a possible explanation of some of these card peculiarities. If, as the valve was opening, or after it opened and before steam was cut off, a wave reached the steam chest, it would record itself locally on the card as an increased pressure which would be called "water" if made on the admission line, and a curiosity if made on the steam line. Of course it could produce no effect after steam was cut off.

Where an engine persists in showing this peculiarity it seems probable that the conditions as to length of steam pipe, pressure carried, revolutions per minute, etc., are right for producing partial resonance, either with the main wave or one of the harmonics, and it would be well to so alter the condition as to break up this resonance in order to avert danger of explosion due to an accidental adjustment of conditions whereby more perfect resonance might occur.

Past and Present Obstacles in the Storage Battery Development.

By Carl Hering.*

The question which the engineer and constructor should discuss at present is not "Is a battery desirable?" but rather "Why is it that storage batteries seem to have been unsatisfactory?" And the question which concerns the capitalist is, "Does it pay in dollars and cents to use the storage battery even if it is kept in a satisfactory condition by the makers?" Limiting ourselves to this country and judging in a general way from the number of storage battery installations, it would seem that the price at present (including, of course, the cost of maintenance) is such that in perhaps the majority of cases the margin of profit to the user is so small or so doubtful that it does not balance the supposed risk. The commendable practice of renting relieves the purchaser of this risk, which then leaves the question a mere matter of cost. A material reduction in the first cost and cost of maintenance would therefore at once turn the tables in many cases so decidedly in favor of the storage battery that there would be little doubt left as to the economy, and it would render the practice of renting unnecessary in most cases.

The chief reason why so few storage battery plants exist in this country seems to have been that the accumulator companies have for years been so busy fighting each other's patents and have spent so much money in this litigation that they have had neither time nor money left to manufacture and install their batteries. But all this litigation has now come to an end, thanks to an enterprising company which has bought up all the little life that is left of these historic "pasted plate" patents. This, together with the fact that it is now conceded by many authorities that for many if not most purposes the unpatented Planté type of cell is the better, removes the chief obstacle to the storage battery development in this country. As the patent question has now been settled, and as cells of the Planté type have now been developed into practical forms, the storage battery outlook at present lies largely in the hands of the constructing engineer, and we should therefore look at the question from this standpoint.

To the user the five chief diseases of the accumulators appear to be: buckling, short circuiting, sulphating, disintegration and dropping out of the peroxide. Many inventors have thought that most of these may be made uninjurious by a process of opposing or resisting their disastrous effects, as distinguished from preventing their occurrence, although the term "preventing" has incorrectly been used to describe it. Buckling has been opposed by main strength and sometimes awkwardness; short circuiting by porous insulating sheets between the plates; falling out, by inclosing or locking the peroxide so that it cannot drop out, etc. Whether and how far such heroic methods have been successful can be determined only by tests. To attempt to prevent the almost irresistible force of expansion of the peroxide from exercising itself by confining the material in an inelastic lead frame, is a formidable, and it seems an almost hopeless task; the inevitable result is that one or the other must give way. If it is the peroxide, it will ultimately be crumbled by the pressure; if it is the lead, there will probably be buckling, or at least a separating of the contact surfaces at the subsequent contraction of the peroxide, and this inevitably results in the formation of that very objectionable layer of white sulphate which practically insulates the active material from its conductor, the consequences of which are sure to be fatal. The development of the storage battery has been greatly retarded by the fact that it was in the hands of mechanical engineers instead of chemists.

The careful constructor should attack the problem in a different way; he should go back to the beginning to find out the prime causes, and then prevent, if possible, these causes from arising, rather than to attempt to oppose their effect by sheer force and awkwardness.

What should be done is to try to construct the plates so that they are adapted to high rates without a great loss of efficiency or capacity. It will be found that in the majority of cases in which the storage battery would be of special value, it is a question of *rate* rather than *capacity;* that is, a great horse power for a short time is more often required than a large quantity of energy delivered at a slow rate. It seems from a number of cases that any capacity above that which is obtained at a 1, 2 or 3-hour discharge is generally of comparatively little value.

To study the effects of rapid discharges it must be remembered that the acid is as important as the lead oxides. When its density falls too low there will be a lowering of the e.m.f.; acid is withdrawn from the solution during discharge, hence the diluted acid in the fine pores of the active material must get out and denser acid must get in; but the only force which does this is the difference between their specific gravities, and as this is very small the force will be small and therefore the circulation will be slow, which in turn reduces the e.m.f. The chemical action will therefore be confined chiefly to the external surface, which is freely exposed to the acid, and the action then becomes so great per unit of surface that white sulphating, or better, complete sulphating, takes place. If a rapid discharge is not to injure the plates nor lower the voltage by reason of the acid in the pores becoming too dilute, the circulation must be rapid. Great porosity accomplishes this partly, but is attended by frailty and poor conductivity of the peroxide, which again results in a fall of the voltage. The ideal method, would, therefore, seem to be a vertical lead plate to act as a good conductor with an extremely large surface and a very thin layer of peroxide on it, freely exposed to a large quantity of acid, which is capable of circulating rapidly. That such a plate may be made to have a greater capacity per pound of plate for rapid discharges and perhaps an equal one for slow discharges, as compared with the best thick, porous plates, has been shown by experiments.

In rapid charging the acid becomes too dense in the pores of a thick mass of active material if the circulation does not keep pace with the demand; this dense acid softens the peroxide and there is a tendency to form gases when the proper chemical action cannot keep pace with the current. Both the softening of the peroxide and the mechanical effects of the gases are injurious. The negative plates being soft and tough, are not so easily injured, but unless the acid can circulate very freely there will still be a lowering of the voltage like with the positive plates, and probably also a lowering of the ampere-hour capacity.

The contact between the peroxide and its conductor must be very good, for, if poor, then a white sulphate forms at the surface, which practically produces an insulating layer, and disastrous effects are then inevitable. The peroxide will insist on expanding during the discharge, and on contracting during the charge. It would be much better to accept this as an inevitable fact than to try to keep the material from obeying the laws of nature by forcibly confining it within an inelastic frame, as many inventors have attempted to do. To hold a large mass of active material firmly in contact with a lead conductor, when one expands and contracts while the other does not, or expands without afterwards contracting again, is a difficult matter. The best solution seems to be to have the active material in the form of an extremely thin layer over a large surface and formed from the lead itself, as this increases its adhering properties. If such a layer can be made porous, and if the surface is made up of small facets, there will be little tendency to buckling or scaling.

The gradual washing away of the surface of the peroxide, and the slow peroxidation and consequent disintegration of the lead support, seem to be absolutely unavoidable. Until some preventive is found, if it ever will be, it seems wisest to accept the inevitable and acknowledge that the positive plates are perishable. To use any other metals or car-

*Abstracts of communications read at the 101st Meeting of the American Institute of Electrical Engineers, New York and Chicago, November 20, 1895.

bon is out of the question ; the addition of antimony to the lead seems to retard but does not prevent peroxidation. The favorite method of trying to avoid the effects of disintegration is to make the frames of the positive plates quite thick, thus prolonging their life. But such a method is certainly not satisfactory for cheap or portable cells, and the gradual washing away of the peroxide remains the same whether the frame is heavy or light, provided that the surface exposed to the liquid is the same.

But there is another way of meeting those unavoidable effects of use, which has recently been applied, and which seems to be a much more rational and effective solution of this vexed problem, at least when lightness and smaller first cost are desired. Instead of making the positive plates heavy and expensive, they may be made very light, cheap and easily replaceable ; their life may then be shorter, but the battery will be as good as new whenever these perishable parts have been renewed. Their life is soon known to the user, and he can then readily determine for himself how much he must allow for amortization. But such a method, to be successful, requires that the old plates and sludge can be converted at a small cost into new plates ; this it seems can now be done, and the writer believes that this alone will have a very important bearing on the outlook of the storage battery, at least for portable cells that are required for traction and many other purposes, or for both portable and stationary plants, if the first cost is an important factor. Such a method becomes practicable only when the chief factor in the cost of the plate is the material, the cost of labor and forming being small.

For stationary purposes, in which the only objection to the weight is the first cost of the lead, good storage batteries have been used abroad with success for some time, provided the rates of charge and discharge are kept low. Assuming that the same storage batteries may be made in this country as well, the question which affects the outlook here is then only one of the cost. But neither abroad nor here does there seem to be a battery in the market in which the weight has been sufficiently reduced and the rate sufficiently increased for a really successful traction battery, the success of which has been demonstrated beyond dispute. It is here assumed that to the public and to railway companies traction batteries are not a demonstrative success until a traction company which has no affiliation with the accumulator makers finds it to its own advantage to use them in preference to other systems.

It seems to the writer that the only batteries which have a promising outlook for this very trying work are those which have a very large surface, very small depth of active material formed electrolytically, and a very free circulation of the acid. The lead frames should be made only thick enough for proper conduction, the batteries must be cheap in first cost, and the positive plates should be capable of being replaced comparatively frequently at small cost. They should be proportioned so that a discharge corresponds to one trip of the car—and only one. To claim as an advantage that a battery can run a car, say four trips, is mere deception, and to the intelligent engineer it is simply an admission that it can do no better. No one would think of carrying four relays of horses on a trailer of a horse car, and why should the equivalent be done with the storage battery unless it is that the battery can do no better and that it cannot be discharged rapidly enough so that the capacity and weight may be reduced to that required to run only one trip? The ideal is certainly a single trip discharge. If the rate for a four-trip battery could be increased four times without materially affecting the capacity, its weight and capacity for a single trip discharge would evidently need be only one-fourth as great. The charging rate should also be equal in hours to the discharge rate, or else it will take a plant of more than two sets of batteries to a car.

The objection to a plate with a thin layer of active material is that it may not retain its charge as well as one with a thick layer or pellets, but in most cases in which rapid rates are desired or cannot be avoided, the small loss in standing is probably more than balanced by the fact that the plates are not injured by rapid rates. As a rule, long periods between charges go hand in hand with slow discharges and less objection to great weight, while short periods between charges, high rates of discharges and lightness usually go together.

In conclusion, the writer desires to make the following recommendations in the interests of engineers who may have to calculate accumulator plants :

The rates of charge and discharge be designated in *hours* and fractions, the current (or for power purposes, the watts) during that time being considered to be kept constant. There can then be no mistake as to what is meant, as this represents the time in hours during which a cell will continue to give a practically constant current before the voltage falls below its limit.

That efficiencies and capacities be always accompanied by the corresponding rate in hours.

That in giving an efficiency it should always be stated whether it is for ampere-hours or for watt-hours.

That for portable batteries intended for power purposes the capacity be given in watt-hours instead of ampere-hours, and that the weight given be that of the complete cell ready for use, as distinguished from the weight of the plates alone.

[Abstracted and Translated for the JOURNAL by MR. HERMAN POOLE.]

Study of the Chemical Purification of Illuminating Gas.

By MESSRS. DELSEAUX and RENARD.

A purifying material which, after having been submitted to the action of a current of crude gas, might be completely saturated with sulphureted hydrogen, is not therefore totally incapable of still exercising some action on the gas; for instance, if at this time oxygen is caused to act on it, the material partially regains its active state, freeing the sulphur. This phenomenon constitutes the regeneration or revivification which will now be considered. We may employ for this regeneration or revivification pure oxygen or oxygen in the form of a gaseous mixture, the principal of which already exists, formed naturally, and is composed of 21 per cent. oxygen and 79 per cent. nitrogen by volume, and constitutes the atmosphere.

In this case the reactions which take place in the material are explained by the following formulas :

$$2Fe_2S_3 + 3H_2O + 6O = 2Fe_2O_3, 3H_2O + 6S.$$
$$4FeS + S + 6O + 3H_2O = 2Fe_2O_3, 3H_2O + 5S.$$
$$2FeS + S + 2O = 2FeO + 3S.$$

The ferrous oxide formed in this last reaction absorbs oxygen rapidly and reproduces ferric oxide :

$$2FeO + O = Fe_2O_3.$$

Besides the protosulphide and sesquisulphide of iron, there is also some bisulphide produced ; its formation is certain, and it is this which produces the difference found between the free sulphur and the total sulphur shown by analysis. If we put into a tube some iron oxide which has been sulphureted and well regenerated by oxygen, heat it and pass a current of hydrogen, we cause generation of sulphureted hydrogen, proving the decomposition of pyrites. This, in presence of oxygen, undergoes a partial oxidation giving rise to sulphuric acid ; but this action is very weak. The formation of pyrites is increased by high temperature and moisture, and it has the objection of rendering a part of the oxide inactive.

We have also established that during the regeneration, magnetic oxide and anhydrous oxide of iron are produced, but the formula—

$$Fe_2S_3 + 3O = Fe_2O_3 + 3S$$

can enter but slightly into the total reaction without causing a diminution, instead of augmentation, after several times of using and regenerating.

Is $2Fe_2O_3 3H_2O$ that which forms principally, or is it another hydrate ? The state of hydration not being definitely settled, we may use a general formula of regeneration :

$$Fe_2S_3 + 3O + 6H_2O = Fe_2O_3, NH_2O + 3S + (6N)\,H_2O.$$

The hydrate Fe_2O_3, NH_2O might be that to which would correspond the maximum activity of the oxide, and would be found in visible proportions in the different natural and artificial oxides, and thus may be explained the greater or less energy with which they act at first, as well as the variation in activity after regeneration.

The preceding reactions are accompanied by others and secondary ones tending to produce Prussian blue :

$$7Fe_2Cy_6 + 3H_2O = 2Fe_7Cy_{18} + 3CyOH + 3CyH ;$$
$$9Fe_2Cy_6 + 3O + 3H_2O = Fe_7Cy_{18} + Fe_2O_3 = 3H_2O ;$$
$$7FeCy_6H_4 + 2O = Fe_7Cy_{18} + 24Cy_6 + 2H_2O.$$

That is, that in presence of oxygen the ferric and ferrous cyanides, as well as ferrocyanhydric acid, are transformed into Prussian blue. The cyanic acid produced in the first reaction is decomposed as follows by the action of water :

$$CyOH + H_2O = CO_2 + NH_3.$$

The cyanhydric acid formed, being volatile, passes off, and we may consider its formation as a loss of cyanogen.

Regeneration in the Open Air.—In some works the waste oxide from the purifiers is immediately spread in thin furrowed layers; this is bad practice. It should be allowed to stand for a time in order to start the action by the accompanying increase of temperature. Then spread out in layers about a foot thick—too thin layers being objectionable as not holding the heat enough. These layers should be worked over at intervals according to the rapidity of the action. Water should not be

	Free Air.					Warm Air.					Warm Air (Furrows.)				
	A. Per Ct.	B. Per Ct.	C. Per Ct.	D. Deg. C.	E. Deg. C.	A. Per Ct.	B. Per Ct.	C. Per Ct.	D. Deg. C.	E. Deg. C.	A. Per Ct.	B. Per Ct.	C. Per Ct.	D. Deg. C.	E. Deg. C.
After 1 hour	....	....	....	7	34	....	....	....	16	37	....	....	....	16	33
" 2 hours	....	....	....	7	36	....	....	....	19	37	....	....	....	19	35
" 3 "	....	....	....	7.5	36	....	....	....	21	36	....	....	....	21	35
" 6 "	....	....	....	10	31	...	....	....	23	33	....	....	....	23	32
" 7 "	....	....	....	10	28	....	....	....	21	31	....	....	....	21	31
" 8 "	....	....	....	10	27	....	....	....	19	28	....	....	....	19	30
" 9 "	29.90	4.50	6.41	10	25	28.33	5.00	6.97	20	28	32.50	4.15	6.14	20	28
" 10 "	....	....	....	....	10	20	....	....	....	20	27	....	....	....	20	26
" 11 "	....	....	....	....	10	18	....	....	....	21	26	....	....	....	21	26
" 12 "	....	....	....	....	10	17	....	....	....	20	26	....	....	....	20	26
" 21 "	27.40	5.50	7.57	10	12	26.06	7.25	9.67	18	25	29.56	4.75	6.74	18	24
" 24 "	....	....	....	10	12	....	....	....	22	23	....	....	....	22	23
" 25 "	....	....	....	10	12	....	....	....	23	23	....	....	....	23	23
" 28 "	....	....	....	11	12	....	....	....	23	22	....	....	....	23	22
" 31 "	....	....	....	12	12	....	....	....	22	22	....	....	....	22	23
" 33 "	27.28	5.30	7.30	11	12	24.73	7.65	10.16	22	18	30.40	4.98	7.15	22	17
" 45 "	28.06	7.80	10.84	9	11	21.16	9.00	11.41	23	19	33.33	6.10	9.15	23	17
" 50 "	....	....	....	10	10	....	....	....	22	19	....	....	....	22	19
" 57 "	28.73	8.00	11.22	12	12	20.80	9.95	12.56	25	21	29.23	6.37	9.00	25	22
" 69 "	31.90	8.25	12.11	10	10	20.16	9.90	12.39	24	23	27.66	7.45	10.30	24	21
" 93 "	32.76	8.35	12.41	12	12	18.93	10.65	13.13	25	25	32.00	7.50	11.02	25	21
" 117 "	32.00	8.20	12.05	12	12	....	....	....	..	..	31.75	7.40	10.85	20	18
" 141 "	....	....	....	..	..	....	....	....	..	..	32.87	7.65	11.40	21	18
" 165 "	....	....	....	..	..	....	....	....	..	..	30.10	7.98	11.42	19	17

added usually till returning to the purifier; it may be used with new, dry or strongly sulphureted material to keep down the temperature and prevent ignition. The statement that the spreading in thin and furrowed layers is bad practice must be modified if we seek Prussian blue instead of iron oxide as the main aim of the regeneration.

Experiments were made with three similar samples from the same material and arranged in beds of 5.9 inches thickness. One was submitted simply to the action of ordinary air; the second to warm air; the third to warm air, but with the bed divided by furrows. At the beginning of the tests the material contained moisture, 34.33 per cent.; free sulphur, 3.60 per cent., or 5.477 per cent. of the material dried and at 20° C.

In the above table Column A shows moisture; B, free sulphur; C, sulphur in dry mass; D, temperature of the air; E, temperature of the mass.

We see by the figures of the table the retardation which accompanies the addition of water even in presence of warm air, a retarding which may amount to a stoppage if we wet the mass too liberally. Therefore regeneration must take place protected from rain—that is to say, well aired but covered.

With regeneration by free air only the upper surface is exposed. An arrangement was made, by means of a false bottom, whereby both top and bottom could be acted on. From this came the idea of regenerating in the purifier itself and so avoiding all handling in the old way.

Regeneration in the Purifier.—The purifier being cut off, we may introduce the air in two ways—by suction or by blowing. At first view the second method seems the better on account of the packing which would accompany the suction. If, then, we compare the results obtained, there can be no more doubt. Two revivification tests in the purifier were made under the following conditions:

A vessel arranged as a purifier was divided by a partition. A sample of the same material as was used in the previous tests was divided equally in the two compartments. The samples tested were average ones. Through one compartment dry air was blown; through the other one air saturated with moisture. The results are as follows:

A, B, C, D are the same as in preceding table; t, t′, t″, temperatures in different portions of the mass.

Dry Air.

	A. Per Ct.	B. Per Ct.	C. Per Ct.	D. Deg. C.	t Deg. C.	t′ Deg. C.	t″ Deg. C.
After 1 hour.	....	....	....	7	28	23	23
" 2 hours	....	....	....	7	39	39	37
" 3 "	29.33	4.40	6.22	7.5	39	40	43
" 4 "	....	....	....	8	38	50	50
" 4½ "	....	....	....	9	38	50	60
" 5 "	....	....	....	9	30	46	50
" 6 "	28.43	5.89	8.24	10	27	42	50
" 7 "	....	....	....	10	25	38	50
" 8 "	....	....	....	10	23	33	45
" 9 "	28.00	6.25	8.68	10	21	28	43
" 10 "	....	....	....	10	18	25	31
" 11 "	....	....	....	10	19	19	28
" 12 "	....	....	....	10	16	19	26
" 15 "	28.00	7.30	10.13	9	13	16	21
" 21 "	28.00	8.10	10.27	10	11	12	14
" 27 "	27.66	8.70	12.11	11	10	10	11
" 33 "	25.30	8.96	12.00	11	9	10	11
" 45 "	23.30	9.51	12.40	9	9	10	10

Moist Air.

	A. Per Ct.	B. Per Ct.	C. Per Ct.	D. Deg. C.	t Deg. C.	t′ Deg. C.	t″ Deg. C.
After 1 hour	....	....	....	7	28	23	22
" 2 hours	....	....	....	7	40	36	38
" 3 "	29.66	4.20	5.97	7.5	37	41	43
" 4 "	....	....	....	8	36	45	46
" 4½ "	....	....	....	9	36	45	46
" 5 "	....	....	....	9	33	42	50
" 6 "	28.66	5.64	7.91	10	32	39	50
" 7 "	....	....	....	10	23	35	48
" 8 "	....	....	....	10	21	30	46
" 9 "	28.40	5.72	8.00	10	22	30	43
" 10 "	....	....	....	10	20	26	40
" 11 "	....	....	....	10	20	24	38
" 12 "	....	....	....	10	20	21	35
" 15 "	29.50	5.95	8.43	9	16	18	27
" 21 "	29.43	7.53	10.41	10	13	13	18
" 27 "	28.90	7.40	10.40	11	12	11	13
" 33 "	29.00	8.18	11.52	11	11	11	12
" 45 "	28.75	8.57	12.03	9	11	11	12

If we examine the figures in the preceding table we will see that the regeneration by dry air may be considered ended in 27 hours, while that with moist air lasts about twice as long. The effect of humidity in the reactions is thus again demonstrated. If we compare the different temperatures we see that the lower part increases first and descends rapidly, and it is the upper part which is the true revivifying portion, and this occurs in inverse ratio to the air current. We see also that the temperature reached by the dry air is not too high, due to the low sulphur content and the rapidity of the current. The regulation of the air current is very important with new, much charged, or with dry material. For instance, repeating the tests above with the material from the bottom of a purifier, and using dry air, the action was so strong that in four hours the temperature had risen to 130° C. and the mass ignited; while with moist air the maximum temperature was only 80° C. If dry air can be used it must be with many precautions, so that if time enough can be had it is preferable to use moist air. Several methods have been proposed to attain this end—adding the water in the bottom of the purifier, moisten the mass or admit a jet of steam into the air current. We prefer the latter method, attaining more uniform action by means of it.

Continuous Regeneration in the Purifier.—This method, which tends to be used more and more, consists in adding in a continuous manner to the gas to be purified, oxygen, pure or in form of a gaseous mixture, and to pass the whole through the purifying material.

With iron oxide air alone is scarcely ever used. It is introduced as close as possible to the hydraulic main, so that the oxygen and the sulphureted hydrogen may be in contact as long as possible and at a high temperature. The following figures give the composition of the gas, to which 2 per cent. of air had been added in the collector:

	Grains per 1,000 Feet.		
	H_2S.	NH_3.	HCy.
After the hydraulic main.	4.88	2.63	1.42
" condenser	1.28	.35	.72
" washer	—	—	—
" scrubber	1.18	.09	.46
" first purifier	.40	.015	.41
" second purifier.	.40	.003	.31
" third purifier.	.40	trace	.26
At the outlet	.40	—	.22

From these results oxygen would act according to the following formula before purification:

$$H_2S + O = H_2O + S.$$

This is confirmed by the figures we now give, which are average results from tests made at various times:

Gas with Two Per Cent. of Air Added.

		Before Charging.	While Charging.	After Charging.
H_2S	Per 100 cubic feet, after the condenser.	1.58	1.12	1.64
	Before the washer....	1.47	.91	1.30
	Difference.....	.11	.21	.34

Gas not Mixed with Air.

H_2S	Per 100 cubic feet, after the condenser.	1.34	1.25	1.60
	Before the washer....	1.30	1.21	1.34
	Difference.....	.04	.04	.26

What takes place in the pipes or condensers may likewise occur in the purifiers, the gaseous mixture finding here more favorable conditions for the reaction of the components on each other; that is, at a certain temperature and in presence of porous material. The following table gives the temperatures and average composition, under these conditions, of a new oxide after a little usage:

		Number of Days of Run.	Analyses of the Material. Results in per Cent. of Dry Mass. S. Total.	S. Free.	SO_3.	HCyS.	Fe_7Cy_{18}.	Moisture of Sample.	Temperature of Mass. Maximum.	Maximum.	Temp. Gas at Inlet. Maximum.	Minim.
1st time with	3d purifier	17	0.07	traces	0.10	0.04	0.29	34.47 per cent.	12.5	7.0	13.0	8.0
	2d "	8	0.26	0.15	0.10	0.11	0.38	31.90 "	17.0	11.0	16.0	11.0
	1st "	15	3.73	2.96	0.40	0.26	1.36	36.93 "	21.0	15.0	14.5	10.0
Revivification in the open air. Moisture on recharging, 27.43 per cent.												
2d time with	3d purifier	15	3.91	3.61	0.41	0.30	1.89	32.50 per cent.	13.0	8.0	13.0	8.5
	2d "	18	13.55	8.90	0.46	0.52	2.93	30.10 "	16.0	9.0	14.0	8.0
	1st "	12	20.33	14.12	0.57	0.83	3.67	31.90 "	20.0	16.0	14.0	9.0

Durability of Iron.

In discussing the above subject before the Engineers' Club, of Philadelphia, Mr. C. D. Rinald says:

I think that a great deal has been said about paint, without reference having been made to the first and chief consideration which should govern the manufacture of a rust-preventing material. The first thing to do is to find out exactly what rust is and how it is caused, as without this knowledge all efforts to protect iron are more or less like groping in the dark. But I think that I can give a plain explanation of the process of rusting, its cause and its prevention, in a more practical and less scientific manner. Rusting is caused by the combination of oxygen with iron, but this combination cannot take place before the iron has been prepared for it by an acid. Now the acid which generally does this preparatory work is carbonic acid, but it may just as well be some other acid (sulphuric, for instance), or it may even be an alkali. Knowing this much, we see readily that one of the duties of a protective coating ought to be to prevent carbonic acid (or other acids or alkalies) from penetrating to the iron, which then cannot combine with oxygen. I might add here that it is easier to protect clean iron than iron which has already started to rust. This is due to the fact that rust is of a hygroscopic nature; that is to say, it attracts water and even water vapors that are anywhere near the iron. You can verify this by placing in the same room alongside of each other a piece of clean iron and a piece of rusty iron, when you will find that the clean iron will remain free from rust, while the other, even if only slightly rusted, will continue to rust, because the rust upon it will attract all the moisture it can possibly get from the atmosphere and transform it into water. The process of rusting may be traced as follows: All the water, as well as dew and mist, in populated districts contains carbonic acid to some extent. This acid, even when deposited in very small quantities upon the iron, will at once dissolve some of the latter and form a soluble ferrous carbonate therewith. The chemical action thus started continues rapidly, the processes which I shall now describe intermingling and helping each other. The ferrous carbonate turns into ferrous bicarbonate when hydrogen is liberated, but is not allowed to pass off, because it at once combines with oxygen, forming water. This oxygen may be drawn from the air or from nearer sources—for instance, oxide paints. But the hydrogen has no greater affinity for oxygen than the ferrous bicarbonate, which will also draw on all available sources for oxygen, and will then rapidly change into ferrous hydrate, on which occasion carbonic acid is set free. Here, then, we have the original carbonic acid which, after having done its duty in forming ferric hydrate, has become free again to dissolve more iron, and now not even liquid water is required to enable the rusting to continue, because the rust thus formed will draw on the atmosphere for moisture, transforming it into water in the manner already described.

After thus considering the origin of rust, let us see what protection against it is offered by paints. Being thoroughly familiar with this subject, I feel warranted in saying that in most paints for iron, cheapness seems to be the chief consideration. It is evident, of course, that a paint that will not protect the iron will prove a very expensive one in the end, no matter how small its first cost may have been.

Before I go any further, I want to say something about that skin of black or magnetic oxide, which has been found under red lead paint. This black oxide is simply rust, containing, however, a relatively smaller proportion of oxygen than the red rust. The red rust consists of two parts (atoms) of iron and three parts of oxygen, while the black rust consists of three parts of iron and four parts of oxygen. This black rust has the same quality as the rust of other metals, that is to say, it will give the iron a perfect protection. To my knowledge it is used exclusively, however, for small articles and not for iron exposed to the weather, the reason being that black oxide, while very hard, is also extremely brittle, and therefore a small piece of it is easily broken or cracked off. As soon as this takes place, the whole coating of black rust immediately turns into a rust producer rather than a rust preventer, because the black oxide is electro-negative and the exposed iron electro-positive. Thus galvanic action of great force takes place and the black oxide is thrown off in a short time by the red oxide. This can be observed frequently on iron signs which have been treated by that method. I wish to say that I have never found black oxide under red lead on bridges, train sheds or like structures, and I think that I may safely claim that nobody else has ever found it on a structure over ground. I first found it mentioned by Mr. Thompson before the Society of Engineers at Manchester, England. If my memory serves me right, he said that he found it under the red lead on the hull of a vessel, or at least on some iron that had been exposed to the action of sea water. I believe that this action and not the red lead caused the formation of the skin, because, as we all know, red lead contains a great deal of oxygen, and would therefore be favorable to the formation of red rust rather than black rust, the latter, as I have before stated, containing more iron and less oxygen than the former. I therefore believe that it would be quite impossible for a skin of black or magnetic oxide to form under a red lead coating on iron which is exposed simply to atmospheric influences.

Considering all the points just touched upon, it seems to me that in making a protective paint, it would be a good idea to use such pigments only as do not contain any oxide at all, and which are not affected by acids or alkalies of such strength as those they will be brought in contact with by the atmosphere or which will be deposited on them by dew, mist, or rain. These principles have been carried out in the manufacture of what is known as "Bessemer" paint.

Now, as to the liquid for mixing a paint, linseed oil is generally considered as the best material for that purpose. I take exception to this. Linseed oil can be made into an excellent liquid for the purpose, but it has to be subjected to a special treatment. In its natural state it is porous and frequently even becomes hygroscopic. It is also easily affected by weak acids and alkalies. It is well known that red lead alone is sufficient to decompose it and to form a lead soap with it. In the first place it should be treated in such a manner that it will no longer contain water, and then its porousness and its affinity for acids must be counteracted. By carrying out all these details, a paint is obtained which will really outlast any other paint for a long time. There is no reason why any gases should penetrate through such paint to the iron, and there is no reason, therefore, why the iron should begin to rust as long as the paint is not injured by mechanical action. As soon as such an injury occurs, a spot is created where rust can get in and work its way under the protective coating, peeling it off. This cannot be avoided, and this shortcoming, paint has in common with all other protective coatings of iron.

[Official Report.]

Meeting of the New York Section of the American Chemical Society.

The members of the New York Section of the American Chemical Society dined at Morello's on the evening of the 6th inst., and from there adjourned to the College of the City of New York, 23d street and Lexington avenue, for the regular monthly meeting. This meeting was held in the lecture room of Dr. Doremus, to which the Society had been invited by Dr. Webb, the President of the institution.

The meeting was called to order by Prof. P. T. Austen. Dr. C. A. Doremus welcomed the Section to its new quarters, and recounted a brief history of the room and the adjoining laboratories, which are now the oldest rooms in the city devoted to chemical research and instruction.

The following papers were read :

P. R. Moale—"A Brief History of Naphthaline."

T. B. Osborne—"Vegetable Proteids."

J. H. Wainwright—"Determination of the Solid Fats in Artificial Mixtures of Vegetable and Animal Fats."

Mr. Moale's paper on naphthaline proved to be an extensive statement of the progress of the development of naphthaline from its first separation by Garden in 1820 from the scale of the condensing vessels used in the distillation of coal tar, believing it to be camphor or something similar thereto, through the work of Faraday begun in 1826, Reichenbach in 1831, to the later work of Dumas, Liebig, Wöhler, Stas, Mitscherlich, Laurent, de Saussure and others.

Passing from the history of the formation and occurrence of this body, the reader took up the composition of the compound, presenting results of analyses by the several noted authorities, and showed that the formulæ of the substance resulting therefrom should be as follows:

Opperman's result	$C_{20}H_8C_2H_2$
Liebig and Wöhler	$C_{20}H_4C_2H_2$
Berzelius	$C_{10}H_4$
Laurent	$C_{10}H_4$ or $C_{40}H_{16}$
Faraday	$C_{20}H_8$
Dumas	$C_{40}H_{16}$
Dumas and Stas	$C_{40}H_{16}$

The reader then took up the constitution of the compound. Beginning with the investigations of Kole and Marignac in this regard, he discussed the results obtained by Berthelot, Ballo, Graebe, Liebermann, Arnheim, Wreden, Claus, Baeyer and Perkin, Fittig, Erdmann and Bamberger, from which it has been shown that the formula established by Graebe is that which must at present be accepted as most nearly the truth.

In the discussion which followed, of the theoretical constitution of naphthaline, Mr. H. S. Neiman was called upon, and gave his experience in attempting the synthetic preparation of naphthaline for the purpose of throwing light on its constitution. He stated that the decomposition of certain amido-naphthol-sulpho acids having a tendency to show that the position of the double bonds in the naphthaline ring are not symmetrical, attempts were made to disprove this by the synthetic production from ortho-xylene-tetra-bromide and ethane. By passing ethane over a heated mixture of granulated pumice stone and ortho-xylene-tetra-bromide, a portion of naphthaline was formed, but circumstances prevented further investigation. This formation would seem to show that the central bond is a double one, and the formula a double one as far as the bonds are concerned.

The second paper on the programme, that of Dr. T. B. Osborne, of the Agricultural Experiment Station at New Haven, Conn., on "Vegetable Proteids," was an exhaustive *resumé* of the classic work of the author upon these interesting and really little known bodies.

The third and last paper on the programme was that of Dr. J. H. Wainwright, of the United States Laboratory, in this city, on the "Determination of Solid Fats in Artificial Mixtures of Vegetable and Animal Fats." His method consists in subjecting the mixture to pressure at the ordinary temperature of the laboratory, about 70° F. Much lower or much higher temperatures he finds detrimental to accuracy, as at 60° considerable of the higher melting point constituents are retained, while at 80° F. and above much of the low melting point constituent is removed.

The method was devised particularly for the separation of compound lards containing cotton-seed oil, lard and stearine, with the special object of determining the percentage of oleo-stearine, which, in the presence of lard, could not be satisfactorily done by the ordinary methods where the information was obtained from the iodine number and other constants. Results were obtained by this method within 1 per cent., but at present, until further investigated, the author allowed 1½ per cent. either way, or a total error limit of 3 per cent. in reporting results.

The General Secretary called attention to the time and place of the next and twelfth general meeting of the Society, which will take place on the 30th and 31st of this month at Cleveland, Ohio, and at which an unusually interesting and valuable programme will be presented.

The next meeting of the New York section will be on the 10th of January, 1896. Durand Woodman, Secretary.

Treatment for Electric Shock.

The recent French Minister of Public Works procured a report from the Academy of Medicine and one from his Departmental Committee on Electrical Matters, on the subject of what should be done in case of an apparently fatal accident through coming in contact with electric wires. He then issued a circular to all the prefects throughout France, directing them to give the contents the widest possible publicity, and to make them known particularly to all local authorities, electric station managers, medical men and chemists in the districts where electricity was in use. The leading parts of the circular are the following:

The medical treatment of cases of shock is the same in all cases, but the measures to be taken for the preservation of the patient, or the safety of the helpers, are different according to whether the current is a continuous or an alternating or commutated alternating one. According to the Academy of Medicine, the victim, even though apparently dead, must be at once taken, if no longer in contact with the electric wires, to a well aired place, the number of persons in which is strictly limited to those whose services are necessary. The clothes are to be loosened (trousers and open shirt), and as promptly as possible you try to re-establish the respiration (as in the case of persons apparently drowned) by rhythmically pulling the tongue or by artificial respiration, and the circulation by rubbing the surface of the body, by whipping the trunk with the hands or with wet napkins, throwing cold water on the body from time to time, and by bringing ammonia or vinegar to the nose.

The method for tongue pulling is to open the mouth, using force by any convenient means, if necessary, as by the handle of a knife or a piece of wood; to grasp the tongue solidly, preferably with the aid of a pocket handkerchief to prevent slipping; to pull the tongue forward, firmly and rhythmically, letting it slacken after each pull, about twenty times a minute, and keep this up for half an hour, an hour, or more. The method for artificial respiration is to lay the victim on his back, shoulders slightly raised, mouth open, tongue free; grasp the arms at the elbows, squeeze them firmly against the chest, then separate them and bring them above the head, describing an arc of a circle; then bring them back to their former position at the sides of the chest. Repeat this about twenty times a minute, and keep it up until natural respiration is restored. It is better to begin, in every case, with the tongue pulling, and, if possible, carry on the artificial respiration at the same time.

If the victim is still in contact with the wires the salvor must, before doing the above, get him away from these. But in order to do that he must himself take certain precautions. For example, he must avoid touching him with the bare hands, and must wear thick gloves of dry stuff—linen or flannel of sufficient thickness; and he must not lay hold of the person injured by any wet or moist part of his body, as by his feet or under his arms. It may be necessary to cut the wires in order to free the body. But this is entirely inadmissable in the case of continuous currents, on account of the risk to the cutter occasioned by the spark or extra current on breaking circuit. It is not so with alternating or commutated alternating currents. In that case the wire may be cut without danger; but it is necessary to cut the wire on both sides of the victim in order to be sure that the cutting is really of use.

The circular goes on to give directions for putting up the above instructions upon the poles, where there are any.

A Gas Engine Crane.

The Parisian Gas Lighting and Heating Company has recently erected a crane driven by a gas engine on its coal wharf at Clichy, France. It is fixed on the staging of the wharf, and the jib, which is pivoted, so as revolve readily, has a radius of 24 feet 7 inches. The crane is designed to lift 1.18 tons of coal in a skip weighing half a ton, or a total load of

1.68 tons, to a height of 63¾ feet, with a velocity of nearly 100 feet a minute. The motor, which runs continuously, and in one direction only, is a 2-cylinder gas engine, with cylinders 9 inches in diameter and 15½ inches long, and develops 15¾-horse power at a speed of 100 revolutions a minute. The revolving of the jib is done by means of bevel friction wheels, and the lifting by means of a grooved friction pulley. The brake is automatic, and must be held in order that the machinery may work. The load is lifted by a wire rope, which passes down the center of the pivot of the jib, and is guided to the grooved winding drum by two pulleys, one of which travels along a screw moved by the drum. The job is curved, formed by braced angles, and counterbalanced at the back by a weight of nearly two tons. All the machinery is covered by a light housing built up to the edge of the dock. With the steam cranes formerly used on this wharf, both a signalman and an oiler were required in addition to the engineer, but with the gas-driven crane one attendant is sufficient. He is stationed close to the edge of the wharf, so as to be able to see into the hold of the vessel that is unloading.

ITEMS OF INTEREST FROM VARIOUS LOCALITIES.

MR. JOHN W. COLEMAN has been elected President of the Oakland (Cal.) Gas Light and Heat Company, to fill the vacancy caused by the death of Mr. Joseph G. Eastland.

THE storeroom of the Sheboygan (Wis.) National Gas Company was destroyed by fire caused by an explosion of gas on the morning of December 11th.

THE Berlin Iron Bridge Company, of East Berlin, Conn., has just completed for the Standard Oil Company, at Constable Hook, N. J., a compounding building 120 feet wide by 130 feet long. The roof trusses are composed of steel, with steel purlins, and covered with galvanized, corrugated iron.

THE Osborne Gas Company has been reorganized at Waukegan, Ill., and it is expected to complete the projected plant for supplying illuminating and fuel gas to the city. L. R. Brittain is the new president.

THE West Side Gas Company, of Wilkes Barre, Pa., will lay mains and supply gas to Edwardsville as soon as the permit to open the streets has been granted.

THE Dansville (N. Y.) Gas Light Company will shortly supply light and power to the inhabitants of Caledonia.

THE Wyandotte Gas Company, of Kansas City, Kas., will expend several thousand dollars on main extensions in the early spring, in order to supply gas to the residents of Armourdale, by whom it will be much appreciated.

THE McClurg Gas Company seems to be very desirous of securing right of way in the streets of Homestead, Pa.

THE following ordinance was recently signed by Mayor Clapp, of Memphis, Tenn.: "Be it ordained by the Legislative Council of the City of Memphis, That the ordinance passed on the 29th day of October, 1895, regulating the price of gas at $1.50 per 1,000 feet, be and the same is hereby amended so as to add thereto the following: 'Section 6. That failure to comply with or a violation of the provisions or any of them of this ordinance be and the same is hereby declared a misdemeanor—each and every instance of such failure to comply or violation being a distinct and separate offense—punishable upon conviction by a fine of not less than $1.00 and not more than $50.00.'"

THE Committee on Ordinance of the Duluth (Minn.) Council is considering an ordinance which was referred to it by the Council on December 9, and which provides for the selling of a new gas franchise to William M. Prindle to make illuminating and fuel gas and lay pipes for the distribution of the same along the streets of the city. The provisions of the franchise are as follows: The territory includes all of St. Croix avenue, First avenue east, Seventh avenue west, Michigan and Railroad streets, Piedmont and Woodland avenues, all the streets east of Fourteenth avenue east, and west of Twenty-seventh avenue west, and all the alleys within those limits. The franchise is to run for thirty years. The company must lay its pipes on one side of the street or the other, in order not to interfere with traffic, etc. The ordinance also provides for condemnation proceedings by the city at the cost of the grantee. The rates shall not exceed $1.50 per 1,000 cubic feet for illuminating gas and $1.25 per 1,000 cubic feet for fuel gas. The company shall pay the city 5 per cent. of the annual gross revenue or receipts, making annual statements under oath. At the end of ten years or any period of five years thereafter, the city may buy the plant by giving twelve months' notice. The appraisers are to decide upon the price within three months after such notice, and the city is then given six months within which to complete the purchase. If the city does not, within that time, buy the plant, then it is to be forever barred from doing so. The company must begin work within three months after filing its acceptance of the ordinance, and a mile of main pipe must be laid within nine months after acceptance.

THE following contracts for street lighting in Jersey City, N. J., have been awarded: Peoples Electric Light Company, 340 arc lights, at $90 per light a year; Hudson County Electric Light Company, 360 lights, at $110 per year. Only 1,000 oil lamps are provided for and they will be furnished by the New York and New Jersey Globe Gas Light Company, at $20.96 per lamp a year. There will be in use only 500 gas lamps, and they will be furnished by the United Gas Improvement Company, at $19.50 per lamp per year.

THE additions and improvements to the Springfield (Mass.) Gas Light Company, which have been going on for some time past, have been completed and are giving satisfactory results in operation.

AT a meeting of the Hartford (Conn.) Street Board, held December 4th, a communication complaining of the condition in which Washington street had been left by the Hartford City Gas Light Company, after digging and filling a trench, was read. Whereupon it was voted that the Superintendent of Streets request the Gas Company to put the street in order by December 15th. On the following Monday morning, President James L. Howard and Commissioners Hills and Cone were driven several times up and down the street in question by General John P. Harbison, of the Gas Company, behind his handsome team of high steppers, and neither of the gentlemen was able to locate the line of the trench. At a meeting of the said Street Board, held the same afternoon, its vote of the previous Wednesday was rescinded.

THE Electric Light and Gas Company, of Centerville, Ia., was recently sold at sheriff's sale to D. C. Campbell, of Chicago. The price paid was $22,000.

THE proprietors of the Charlestown (Mass.) Gas Company have issued the following notice: That commencing January 1st, 1896, the price of gas will be reduced to $1.25 per 1,000 cubic feet if paid by the 15th day of the month, bills to be rendered monthly.

THE Commissioners, Washington, D. C., have added the following section to the gasfitting regulations: "Stopcock boxes for gas service pipes shall be of a pattern approved by the Commissioners of the District of Columbia, and shall be located in sections 55 and 57 of the plumbing regulation for water stopcock boxes. If otherwise located or requiring adjustment to grade, they shall be moved or adjusted at the expense of the Gas Light Company responsible for their maintenance."

THE Syracuse (N.Y.) Gas Company has been incorporated at Albany, N. Y., with a capital stock of $2,500,000.

THE Sioux City (Ia.) Gas Light Company, after agreeing to reduce the price of gas, on and after Jan. 1, 1896, from $2 to $1.60 per 1,000 cubic feet, with a discount of 10 cents per 1,000 if paid at Company's office before the 10th of month following that during which gas was consumed, furnished the Light Committee of the City Council with the following interesting statement showing the gas sold each year since and including 1885: Gas sold in 1885, 8,103,100 cubic feet; 1886, 10,932,500 cubic feet; 1887, 15,889,000 cubic feet; 1888, 20,500,000 cubic feet; 1889, 24,489,900 cubic feet; 1890, 27,141,890 cubic feet; 1891, 30,457,142 cubic feet; 1892, 29,670,000 cubic feet; 1893, 34,112,000 cubic feet; 1894, 34,525,000 cubic feet. The first ten months of 1894 showed 26,994,257 cubic feet sold, and the same period of 1895 showed 26,276,625 cubic feet, making a decrease of 715,232 cubic feet, as compared with the previous year. The following shows the price charged for the gas per 1,000 cubic feet during this period: 1884 to June, 1887, inclusive, $3 gross, with discount of 50 cents, making $2.50 net. June, 1887, to May, 1890, inclusive, $2.50 gross, without any discount. May, 1890, to date, $2 gross, with the following discounts: Five per cent. on bills

under $10 per month, equaling $1.90 net; 10 per cent. on bills between $10 and $20 per month, $1.80 net; 15 per cent. on bills over $20 per month, $1.70 net; 25 per cent. for gas used for fuel, $1.50 net.

THE Chatham (Ontario) Gas and Electric Company are about to remodel their plant by installing new and enlarged apparatus and machinery.

THE Newark (N. J.) Gas Company has purchased the old Central Hotel property, at Broad street and Central avenue, for $65,000, from the heirs of the Ward estate, and will erect a fine office building there next spring. The property fronts 72 feet 5 inches on Broad street, runs back 35 feet full width and then slopes to a width at the rear of 24 feet 6 inches, the length on Central avenue being 97 feet 8 inches. There are two fine brick buildings on the Central avenue side, and these will be left as they are; but the 3-story frame hotel building on Broad street will be torn down and a substantial stone or brick office building erected on the site.

CERTAIN parties are attempting to secure control of the Atlantic City (N. J.) Gas and Water Company, and a large block of stock recently changed hands at $29 per share. The par value is $25, and the price at which the stock is now held is said to be $40.

IT is stated that the Excelsior Coke and Gas Company, of Topeka, Kas., has been sold to New York and Boston capitalists. The price paid is said to have been $280,000, and work is shortly to be commenced on extensive improvements.

ABOUT three months ago Mr. E. C. Jones, Engineer of the San Francisco Gas Light Company, was called to Vallejo, Cal., to inspect the Gas Company's plant and devise means of increasing its holder capacity. His advice was to make a telescopic holder out of the single lift then in use, which was finally done, under Mr. Jones' supervision, by the Bay City Iron Works, of San Francisco, without putting the holder out of service. The completed work is giving entire satisfaction, and was a great saving to the Vallejo Company as against the cost of a new holder.

MR. B. G. WHITEHOUSE, Cashier of the Portland (Ore.) Gas Company, received a pleasant surprise on Thursday, December 5th, when he was presented with a gold-headed cane by the employees in the Company' office. It was about 6 o'clock, when Mr. A. H. Wilson, one of the office staff, who represented the boys, made the presentation to Mr. Whitehouse, accompanying it with a neat little speech. Mr. Whitehouse was completely taken by surprise, but managed to pull himself together sufficiently to express the pleasure that the presentation had caused him. The cane is a beautiful stick, the gold head being engraved with an inscription that read: "B. G. Whitehouse, from the 'Boys' of the Gas Company's Office."

THAT the Columbus (Ohio) Gas Company is up to date in pushing the introduction of appliances for the consumption of gas is instanced by Mr. Butterworth's new announcement cards, which are posted in the street cars of the city, setting forth that the Gas Company can transform ordinary oil lamps into Welsbach reading lamps at very small expense and with extreme neatness.

ARTICLES of incorporation have been filed with the Secretary of State for the Dual City Gas Company, of Grand Forks, North Dakota, with a capital stock of $50,000. This Company will succeed the Economic Gas Company, which was established in Grand Forks about three years ago. The incorporators of the new concern are James Twamley, F. K. Kohlen, E. W. De Lorimer, E. M. Upson, C. J. Fisk, J. W. Brooken and B. V. Paulness.

THE City Council of La Fayette, Ind., at a meeting held on the 10th inst., renewed the contract with the La Fayette Gas Company for lighting the streets of that city for a period of five years from the date of the expiration of the present contract, which has about a year and a half to run. The city is to-day paying $75 per year for each street lamp in use. Members of the Council recently visited a number of cities where the municipalities own their own lighting plant, with a view of ascertaining what the outlook was for putting in a plant for the city. They obtained an estimate of the cost of such a plant, but nothing further was done about it, for the reason that the city is at present up to the limit of its bonded indebtedness, having $300,000 in water works bonds. The Committee on Light, with the City Attorney and City Engineer, have recommended the making of another contract with the present gas plant of the city, which recommendation has been adopted. The Company came before the Committee and voluntarily offered to make a reduction in the cost of lamps, provided the contract was extended for five years. After figuring over the cost of a new plant, without putting in anything for interest on an investment of $100,000, the Council Committee was unable to bring the cost of lamps below $63.57 per annum. The present Company agreed to enter into a contract to give a first-class light for $66 per lamp—a cut of $9 per lamp from the price now being paid by the city. In addition, the Company offered to cut the commercial rates 20 per cent. from the charges now made, and the incandescent rates are to go down 25 per cent. from present rates. In this way the entire city gets the benefit of the reduced prices, all to take effect January 1st. Prior to the making of the present contract, the Brush and Thomson-Houston Companies were both doing business. The city made an exceedingly advantageous contract at that time, the Brush Company offering to furnish street lamps for $50.60 a year. The City Council made a three-year contract, with a privilege of two years additional. When next the bids were invited, both Companies were bidders, but the figures were greatly advanced, the Brush asking $75 per lamp per year, and the Thomson-Houston $83. The Council again awarded the contract to the Brush Company, but soon after the plant was sold to the Thomson-Houston Company, which at that time owned the artificial gas plant of the city. Two years ago the Deitrich syndicate purchased the natural gas plant, and some months later the same corporation took in the Electric Light and Gas Companies, so the present Company really has two electric lighting companies in one, the machinery of the Brush having been moved to the Thomson-Houston site and rebuilt.

THE town of Deseronto, Canada, where there are several large lumber mills, is partially lighted by gas made from sawdust. The sawdust is charged in retorts which are heated by a wood fire, the gas from the retorts passing into a series of coils and thence into the purifiers, which are similar to those used for coal gas. Lime is the principal purifying agent employed.

PROF. P. B. WILSON, Inspector of Illuminating Gas and Oils, of Baltimore, Md., is the first city official to submit his annual report to Mayor Hooper. The document, which was filed December 13, says that the quality of gas furnished by the Consolidated Gas Company has been above the standard during the year.

THE suit of Louis A. Levin against the Chicago Gas Company has been dismissed by Judge Horton. It was brought more than a year ago, and the bill filed asked for the appointment of receivers for all the Chicago Gas Companies, although the principal defendant mentioned was the Chicago Gas Light and Coke Company. Levin alleged that he was the owner of certificates of stock issued by the Fidelity Company, of Philadelphia. He charged that the Gas Companies of Chicago had placed their stock in the hands of the Fidelity Company and that the latter had elected officers who control all the Companies. The individual stockholders, he charged, were thus deprived of any voice in the management of the properties. When the matter came up Judge Horton held that the complainant and his bill had no standing in court, for the reason that he had not made the Fidelity Company a party to the bill.

BIDS for lighting the streets and public buildings of Brooklyn, N.Y. during 1896, were opened on the 16th inst. by Commissioner White. The bidders were the Edison Company, the Citizens Company and the Kings County Electric Light and Power Company, the last named being the latest competitor in the field. It was this Company's first bid. The bid of the Citizens Company was: For arc lights of 1,200-candle power, 35 cents a light a night. If 400 additional lights a night are provided, a reduction of 1 cent a light a night will be made. In the event of a reduction of the number of lights below those in use on December 31, 1895, the rate will be 40 cents. For lighting public buildings 2 2-10 cents per ampere hour. The Edison Company bid 35 cents for arc lights of 1,200-candle power and 17½ cents for 600 candle power, all additional lights to be furnished for 20 cents a lamp a night. If the number is reduced, the rate will be 40 cents. For lighting public buildings 8 10 cents per lamp hour for incandescent lamps of 16-candle power; arc lights 1,200-candle power, 7 cents per lamp hour. Kings County Electric Light and Power Company, arc lights, 1,200 candle power, 32 cents a lamp each night. This Company's bid covers only Fulton street to Snediker avenue and Court street to First place. The Company makes the same bid for streets on which it may hereafter have circuits as the department might designate.

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MONDAY, DECEMBER 23, 1895.

The Thermophone.

This is an electrical apparatus in which sounds are produced by the changes in the circuit due to variations of temperature. Its use is to measure temperature, particularly the temperature in a distant or inaccessible place; at the bottom of a pond, for instance. For obtaining deep sea temperatures it is useful, and it may also prove of great service in the ventilation of buildings, for by this instrument the temperature of any room in a building can be registered on a dial placed in the hall. The scientific uses of the thermophone are obvious, and it will be of great aid to physicists in determining the fluctuations in the temperature of the soil and the difference in temperature between the water at the surface and that at the bottom of ponds and lakes.—*Scientific American.*

A New Translucent Roofing.

It is stated that about 5,000 square feet of surface on top of the roof monitor of a new forge shop in East Berlin, Conn., consists of an impervious material designated as translucent fabric, which possesses the property of transmitting the light quite well, though giving it a decided yellow tinge. The material consists of a wire cloth, having a mesh of about an eighth of an inch, covered with a product of linseed oil which resembles a flexible gelatine, made by a process not yet disclosed. This roof is said to have sustained itself through severe rain storms without any leaking, cracking or changing of its shape, the material also remaining unignited when exposed to a temperature of 800° F. It has been in use, too, without injury on a foundry skylight inclined at an angle of 45°, within 20 feet of a chimney blowing out sparks and small pieces of molten metal. The fabric weighs from a seventh to a tenth as much as ordinary skylight glass, and is claimed to be especially adapted for skylights of factories and shops, particularly those having iron roofs—differing, according to the description, from what is known as wire glass, in being much stronger as well as a poorer conductor of heat, and by no means transparent.

How Electricity Sets Fire.

William McDevitt, Chief of the Electrical Department of the Philadelphia Underwrtiters' Association, in a recent issue of the Boston *Transcript*, gave a demonstration of some of the ways in which fires may be caused by electricity. The first danger was that arising from the common practice of grounding telephone wires on gas pipe. A bad connection is generally made—quite sufficient for telephone purposes—and then if the telephone wire becomes crossed with an electric wire, the larger current meeting resistance at the ground connection heats the joint, punches a hole in the gas pipe, and the arc formed lights the gas. Mr. McDevitt gave a complete demonstration of the gas and insulation on the wire burning simultaneously. He also exhibited a section of gas pipe that had caused a fire in just this way. The wires in the sockets of electric lamps are liable to touch the casings, when an arc may be formed. For this reason, no drapery should be used around the lamp sockets. The advantage of using metal conduits with insulatep lining through which to run the wire was demonstrated, a wire outside being dangerously heated, while from that inside the conduit there was no risk. A caution was given against the rough handling of flexible cords used for electric lights as a common cause of short circuits and fire.

There are other dangers due to ignorance on the part of the general public of the character of the electric current. In one case on record, the walls of a room were upholstered with stuff in which were interwoven a great number of metal threads. These were in contact with the electric light wires, and when the current was turned on the whole room was set ablaze. An obscure danger from frictional electricity has been traced. Sparks may be caused by shuffling the feet on the carpet or by rubbing of silk. Where benzine is used to clean such materials, a spark thus caused may give rise to a dangerous fire. It is believed that some benzine fires have been caused in this way.

The Market for Gas Securities.

The worst panic known in New York since 1873 is in progress in Wall street to day (Friday) as we go to press. Consolidated gas, which closed last night at 152 bid, asked 153, has sold down to 139 to-day at 12:30 o'clock, and apparently will go lower. Chicago gas, which closed yesterday at 68½, has just sold at 61½. It is impossible to give reliable figures for any securities in the face of present uncertainty and war rumors caused by the President's messages and the impending possibility of excessive gold shipments abroad. At auction, on Wednesday, 20 shares Mutual sold at 248, and 100 shares Standard preferred brought 109½.

Gas Stocks.

Quotations by Cochran & Close, Brokers and Dealers in Gas Stocks.

35 WALL ST., NEW YORK CITY.

DECEMBER 23.

☞ All communications will receive particular attention.

☞ The following quotations are based on the par value of $100 per share:

N. Y. City Companies.	*Capital.*	*Par.*	*Bid.*	*Asked.*
Consolidated	$35,430,000	100	..	139
Central	500,000	50	150	..
" Scrip	220,000	..	100	.
Equitable	4,000,000	100	228	230½
Bonds, 6's	1,000,000	1,000	106	..
" 1st Con. 5's	2,300,000	1,000	114	.
Metropolitan Bonds	658,000	..	108	112
Mutual	3,500,000	100	250	260
" Bonds	1,500,000	1,000	100	102
Municipal Bonds	750,000	..	..	.
Northern	150,000	50	79	80½
" Bonds	150,000	1,000	..	98
New York and East River	5,000,000	100	39	40
Preferred	2,000,000	100	73	76
Bonds 1st 5's	3,500,000	1,000	102¾	03½
" 1st Con. 5's	1,500,000	..	90	90¼
Richmond Co., S. I.	348,650	50	50	..
" Bonds	100,000	1,000	..	..
Standard	5,000,000	100	73¾	74
Preferred	5,000,000	100	..	108½
Bonds, 1st Mortgage, 5's	1,500,000	1,000	109¼	111½
Yonkers	200,650	50	112	..
Gas Co's of Brooklyn.				
Brooklyn	2,000,000	25	140	..
Citizens	1,200,000	20	70	..
" S. F. Bonds	320,000	1,000	..	101
Equity	2,000,000	10	..	..
" Bonds	1,000,000	..	..	..
Fulton-Municipal	3,000,000	100	220	..
" Bonds	300,000	..	108	..
Peoples	1,000,000	10	100	.
" Bonds, 7's	368,000	..	100	..
" " 6's	94,000	..	98	100
Metropolitan	870,000	100	200	..
" Bonds, 5's	70,000	..	..	..
Nassau	1,000,000	25	310	..
" Ctfs	700,000	1,000	99	100
Williamsburgh	1,000,000	50	310	..
" Bonds	1,000,000	..	107	110
Out-of-Town Companies.				
Bay State	5,000,000	50	20	22
" Income Bonds	2,000,000	1,000	..	30
Boston United Gas Co.—				
1st Series S. F. Trust	7,000,000	1,000	79½	81
2d " " "	3,000,000	1,000	..	58
Buffalo Mutual	750,000	100	125	..
" Bonds	200,000	1,000	95	100
Central, San Francisco	2,000,000	..	95	..
Chicago Gas Co.	25,000,000	100	..	61½
Chicago Gas Lt. & Coke Co. Guaranteed Gold Bonds.	7,650,000	1,000	94	94¼
Columbus	1,069,000	..	66½	67
1st Mortgage	1,085,000	..	94	95
Consumers, Jersey City	2,000,000	100	..	88
" Bonds	600,000	1,000	100	103½
Cincinnati G. & C. Co.	7,000,000	100	203¾	..
Consumers, Toronto	1,600,000	50	184½	187
Capital, Sacramento	500,000	50	..	41
Bonds (6's)	150,000	..	..	..
Consolidated, Baltimore	11,000,000	100	60½	61
Mortgage, 6's	3,600,000	..	107	107½
Chesapeake, 1st 6's	1,000,000	..	..	..
Equitable, 1st 6's	910,000	..	..	..
Consolidated, 1st 5's	1,490,000	..	..	..
Detroit	4,000,000	..	29½	30¼
" Con. Bonds	4,312,000	..	71½	75
Equitable Gas & Fuel Co., Chicago, Bonds	2,000,000	1,000	..	101
Fort Wayne	2,000,000	..	76½	78½
" Bonds	2,000,000	..	80	91
Hartford	750,000	25	130	135
Indianapolis	2,000,000	..	142	147
" Bonds, 6's	2,650,000	..	103	105
Jersey City	750,000	20	180	..
Lafayette Gas Co., Ind	1,000,000	100	83	85
Bonds	1,000,000	1,000	85	87
Louisville	2,570,000	50	..	130
Laclede, St. Louis	7,500,000	100	23½	24
Preferred	2,500,000	100	83¾	84½
Bonds	2,064,400	1,000	95½	96
Little Falls, N. Y.	50,000	100	..	100
Bonds	25,000	..	..	100
Montreal, Canada	2,000,000	100	200	.
Newark, N. J., Gas Co.	1,000,000	..	75	.
Bonds, 6's	4,000,000	..	120	..

New Haven	1,000,000	25	225	..
Oakland, Cal.	2,000,000	..	46½	..
" Bonds	750,000	..	..	..
Peoples Gas Lt. & Coke Co., Chicago, 1st Mortgage	2,100,000	1,000	..	108
2d "	2,500,000	1,000	104	105
Peoples, Jersey City	500,000	50	..	175
Paterson, N. J.	.....	25	99	102
Rochester Gas & Elec. Co.	2,150,000	50	..	..
Preferred	2,150,000	50	88	..
Consolidated 5's	2,000,000	..	87½	90
San Francisco, Cal.	10,000,000	100	71½	72
St. Paul Gas Light Co.	1,500,000	100	68½	70
1st Mortgage, 6's	650,000	..	88	90
Extension, 6's	600,000	..	..	..
General Mortgage, 5's	2,400,000	..	88	90
Syracuse, N. Y.	800,000	25	..	..
Washington, D. C.	2,000,000	20	250	..
Western, Milwaukee	4,000,000	100	68	70
Bonds, 5's	3,556,000	..	93	94½
Wilmington, Del.	500,000	50	188	190

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Superintendent in charge of gas works making 17,000,000 cubic feet per annum desires change of locality. Has been with present company five years. Address

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8-inch Connections.

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54 inches in diameter, 8 inch connections. Must be in good order. Address,

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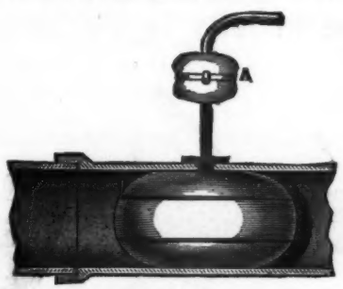

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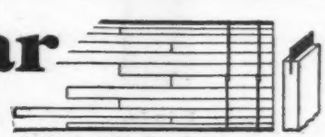

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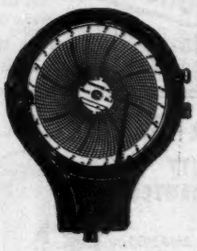

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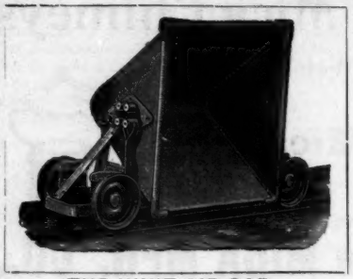

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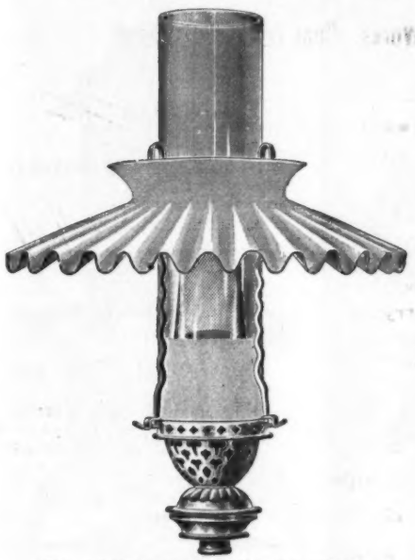

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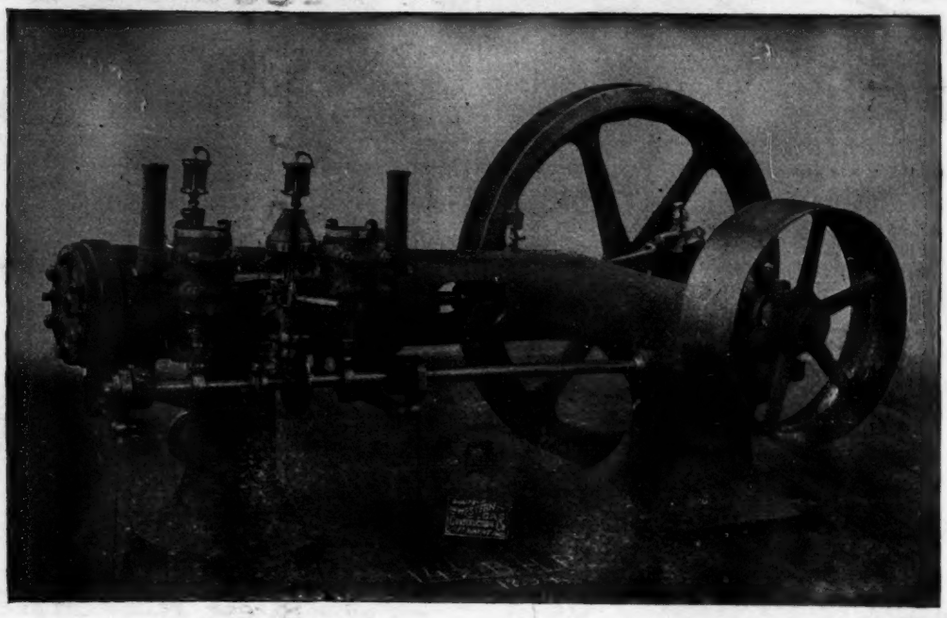

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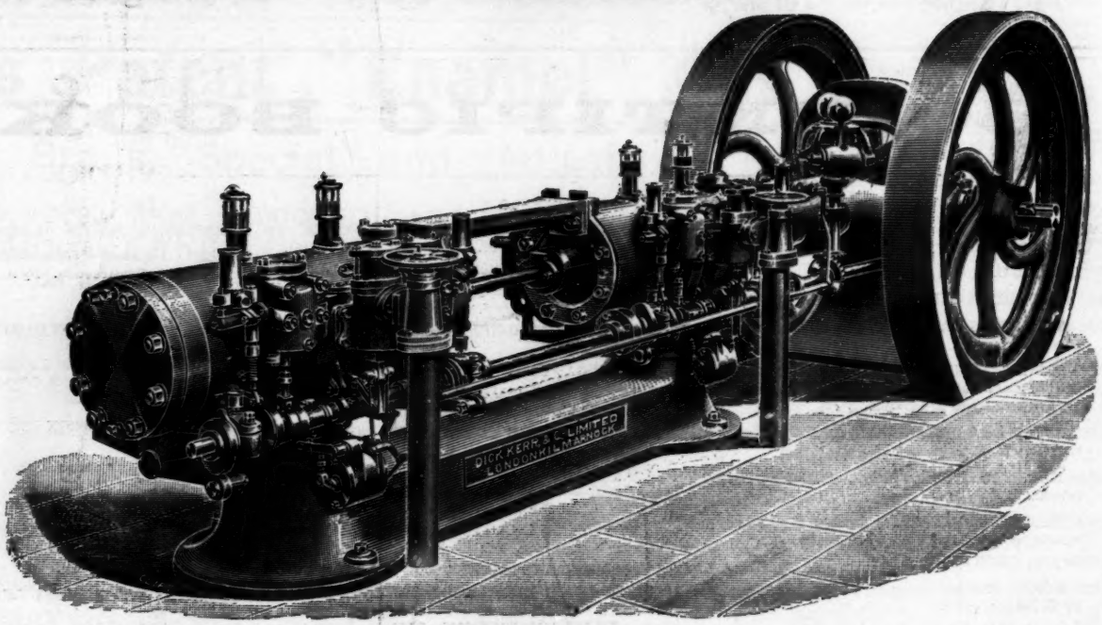

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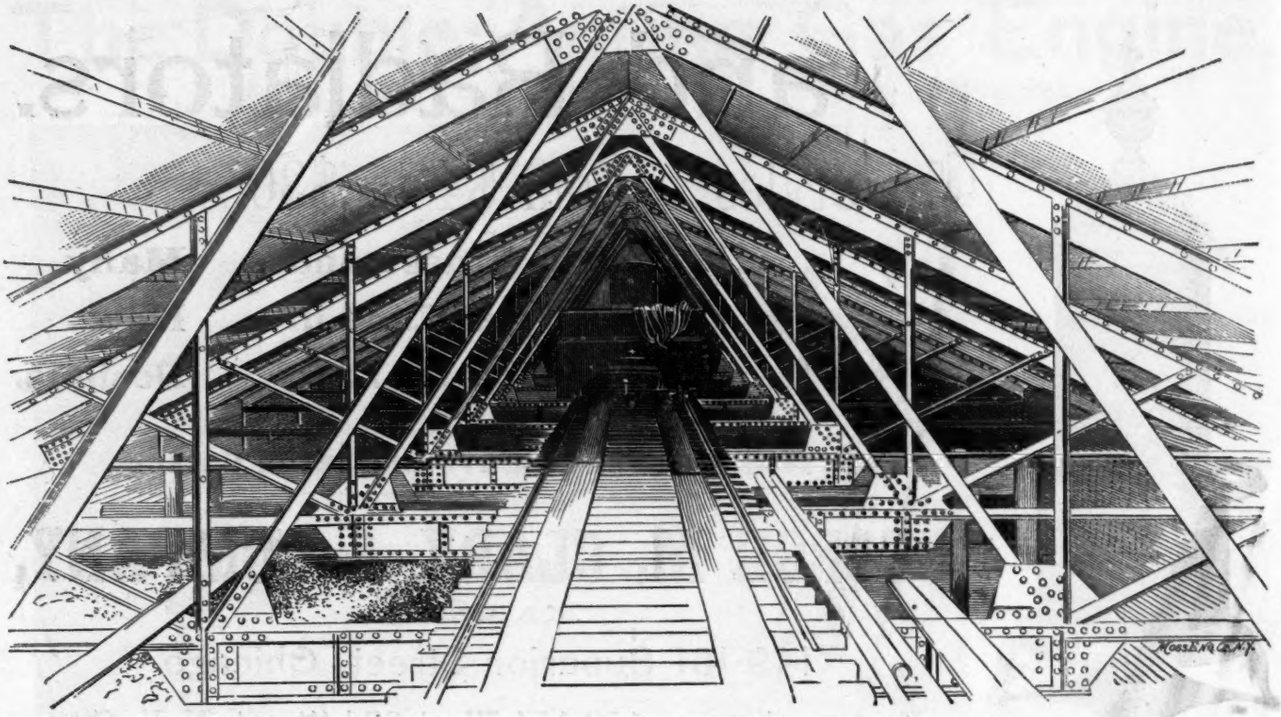

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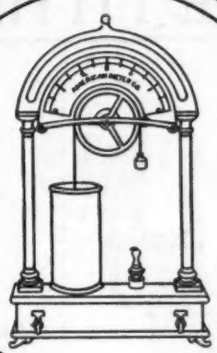
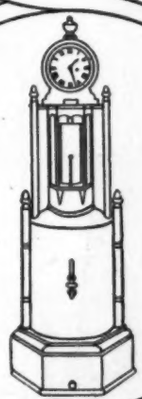
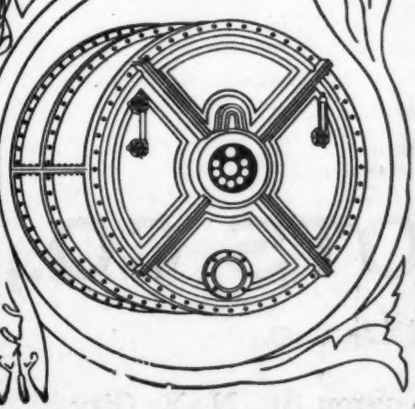


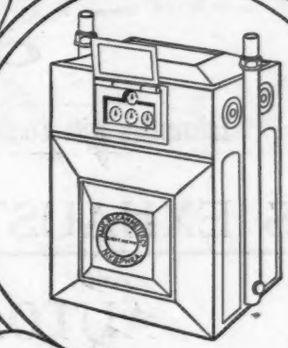




PUBLIC LIGHTING TABLE.

JANUARY, 1896.

Day of Week.	Date.	Table No. 1. Following the Moon. Light.	Extinguish.	Table No. 2. New York City. All Night Lighting. Light.	Extinguish.
				P.M.	A.M.
Wed.	1	No L.	No L.	4.30	6.30
Thu.	2	5.20 PM	7.50 PM	4.30	6.30
Fri.	3	5 20	9.10	4.30	6.30
Sat.	4	5.20	10.30	4.30	6.30
Sun.	5	5.20	11.40	4.30	6.30
Mon.	6	5.20	12.50 AM	4.30	6.30
Tue.	7	5.20 LQ	2.10	4.30	6.30
Wed.	8	5.20	3.20	4.40	6.30
Thu.	9	5.20	4.30	4.40	6.30
Fri.	10	5.20	5.40	4.40	6.30
Sat.	11	5.20	6.20	4.40	6.30
Sun.	12	5.30	6.20	4.40	6.30
Mon.	13	5.30	6.20	4.40	6.30
Tue.	14	5.30 NM	6.20	4.40	6.30
Wed.	15	5.30	6.20	4.50	6.25
Thu.	16	5.30	6.20	4.50	6.25
Fri.	17	5.30	6.20	4.50	6.25
Sat.	18	5.30	6.20	4.50	6.25
Sun.	19	8.50	6.20	4.50	6.25
Mon.	20	9.50	6.20	4.50	6.25
Tue.	21	10.50	6.20	4.50	6.25
Wed.	22	11.50 FQ	6.20	5.00	6.25
Thu.	23	1.00 AM	6.20	5.00	6.25
Fri.	24	2.00	6.20	5.00	6.25
Sat.	25	3.10	6.20	5.00	6.25
Sun.	26	4.10	6.10	5.00	6.25
Mon.	27	5.10	6.10	5.00	6.25
Tue.	28	No L.	No L.	5.00	6.25
Wed.	29	No L. FM	No L.	5.05	6.15
Thu.	30	No L.	No L.	5.05	6.15
Fri.	31	5.50 PM	8.10 PM	5.05	6.15



TOTAL HOURS LIGHTING DURING 1896.

By Table No. 1.	Hrs. Min.	By Table No. 2.	Hrs. Min.
January	220.40	January	423.20
February	207.00	February	367.40
March	193.00	March	355.35
April	174.10	April	298.50
May	164.00	May	264.50
June	142.10	June	234.25
July	142.10	July	243.45
August	150.50	August	280.25
September	163.00	September	321.15
October	193.10	October	374.30
November	207.00	November	401.40
December	237.30	December	433.45
Total, yr.	2194.40	Total, yr.	4000.00

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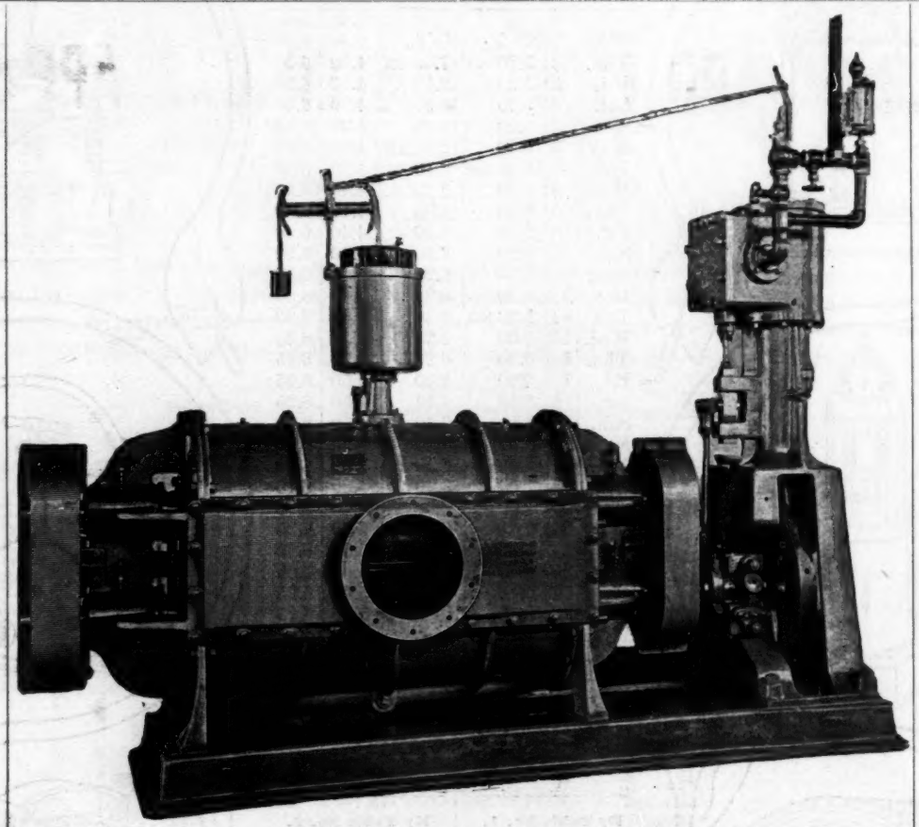

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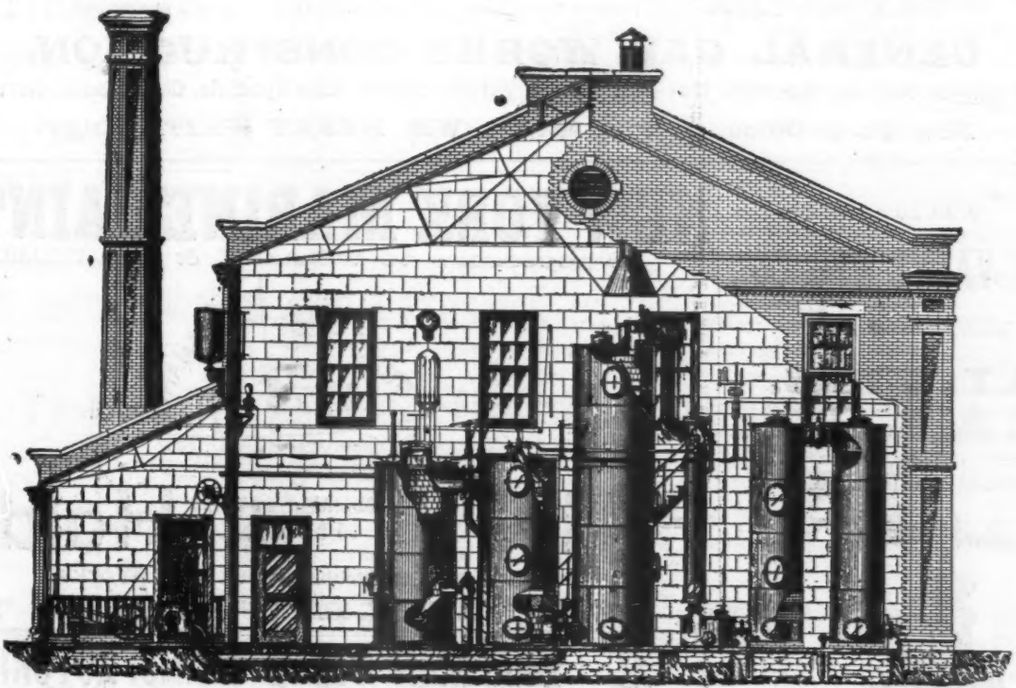

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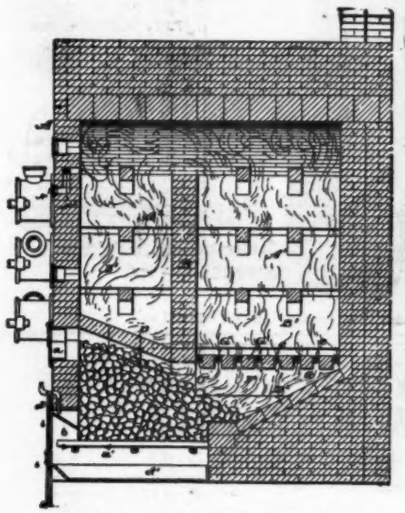

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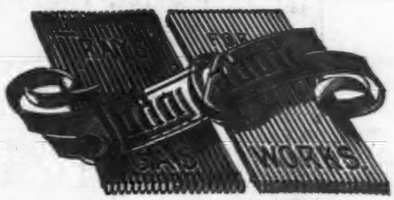

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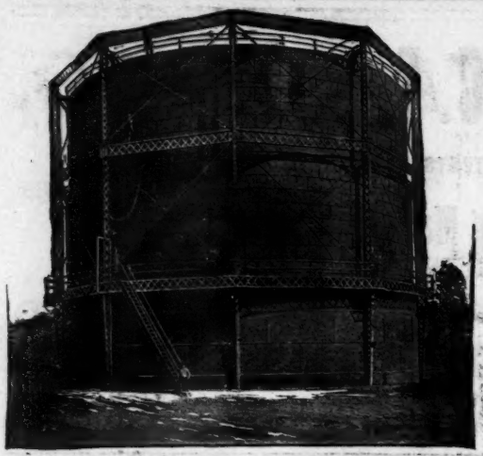

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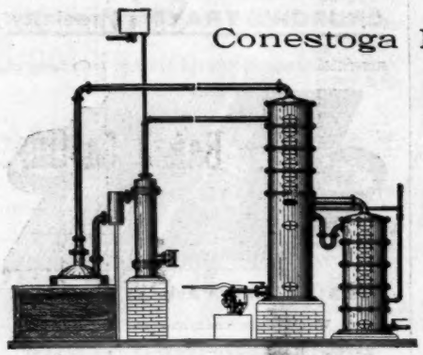

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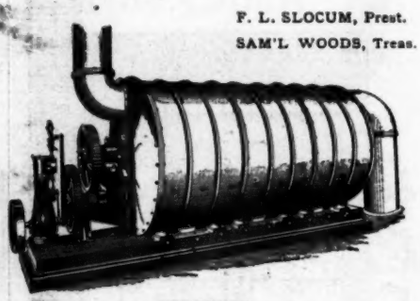

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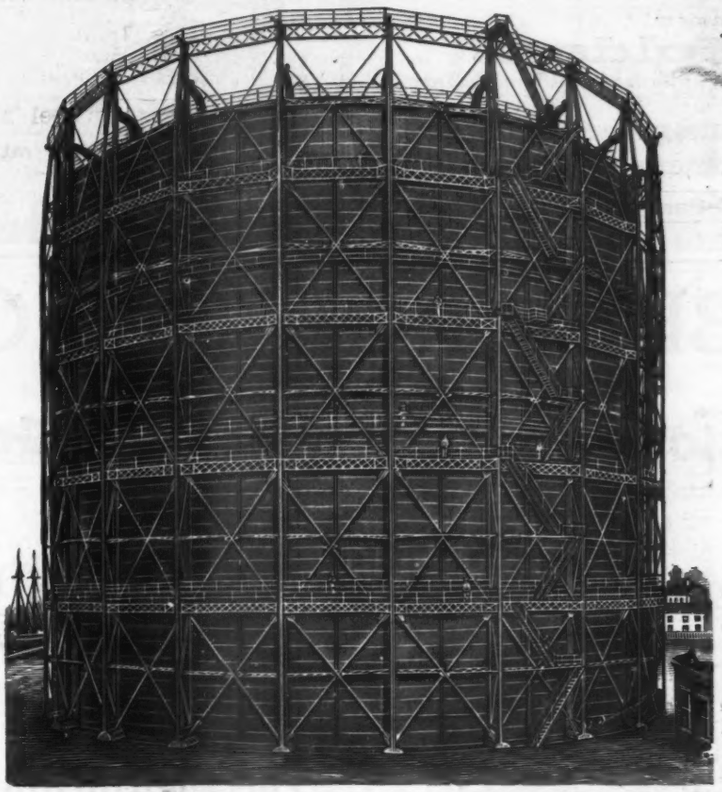

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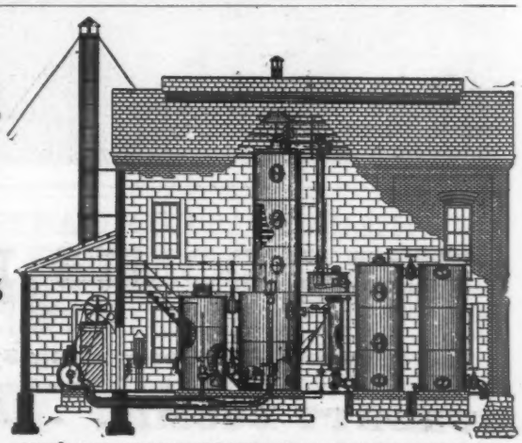

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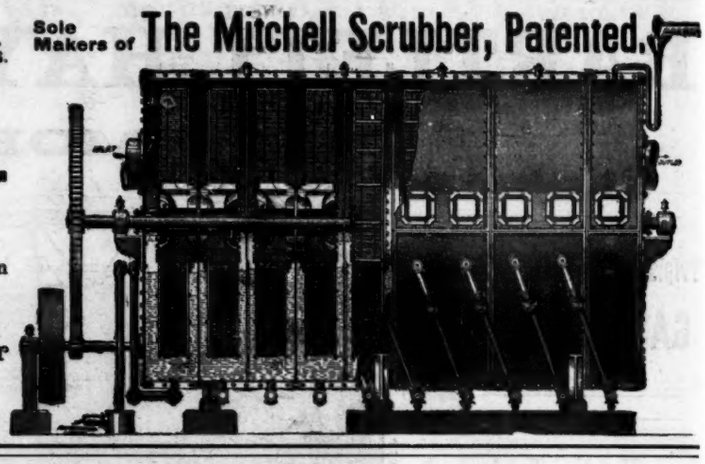

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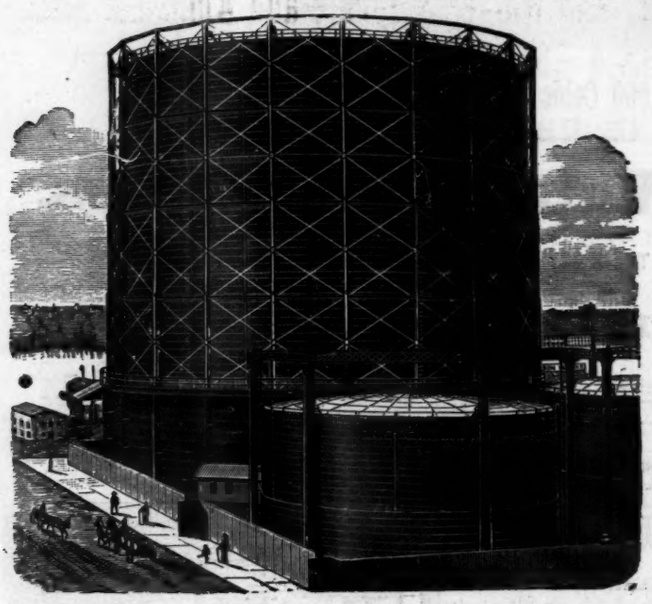

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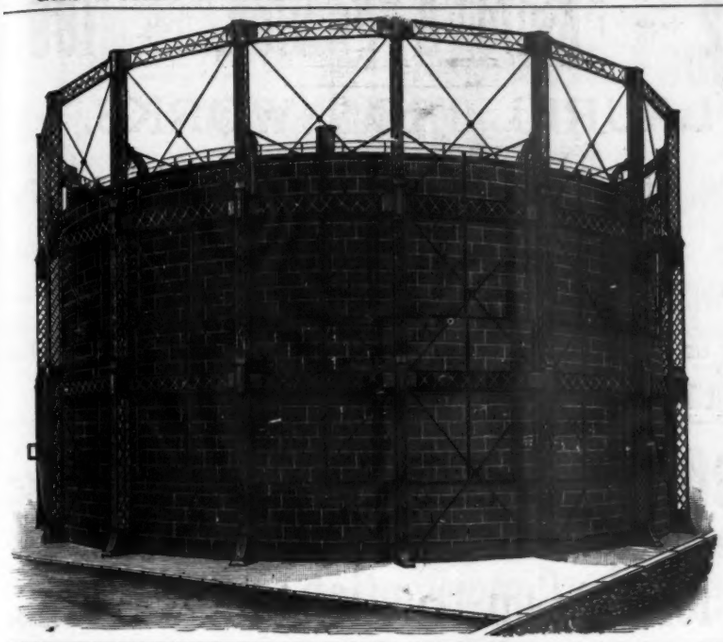

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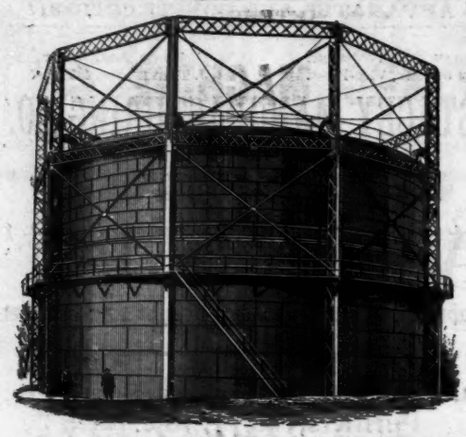

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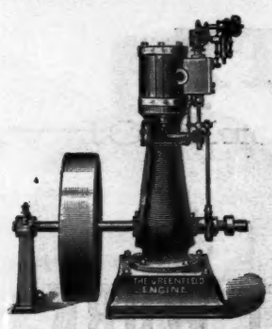

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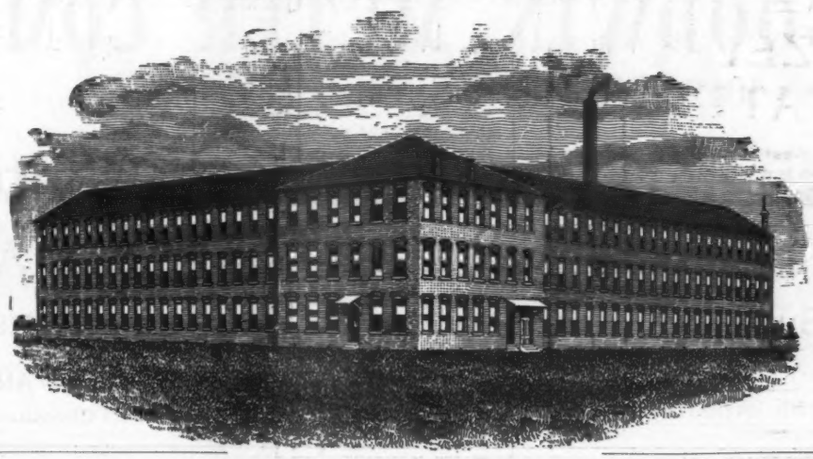

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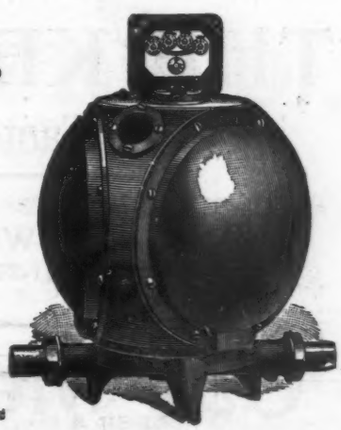

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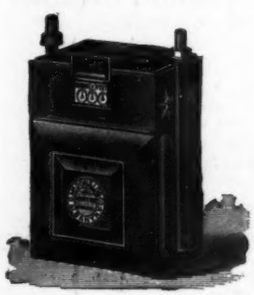

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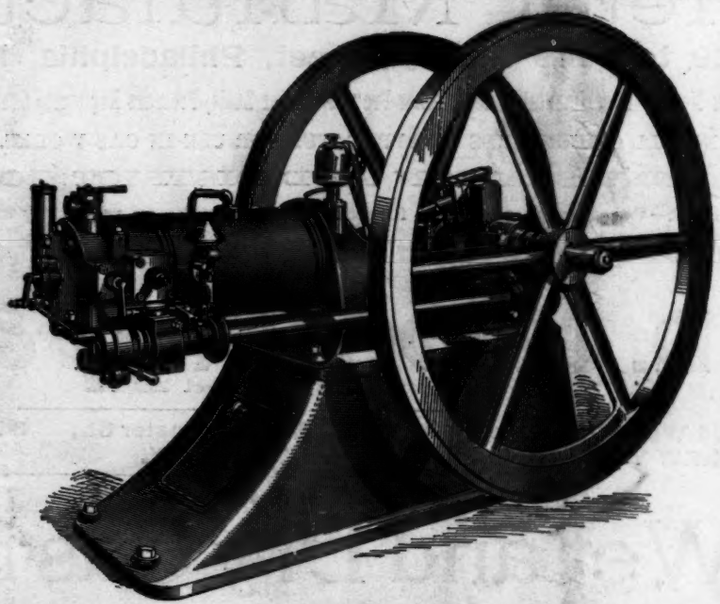

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